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DOE National Low Level Waste/Mixed Low Level Waste Disposition Strategy



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Department of Energy National Low-Level Waste and Mixed Low-Level Waste Disposition Strategy

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Department of Energy National Low-Level Waste and Mixed Low-Level Waste Disposition Strategy

Executive Summary

The National Low-Level Waste (LLW)/ Mixed Low-Level Waste (MLLW) Disposition Strategy (NDS) provides a complex-wide program plan for LLW/MLLW management and designs a complex-wide strategy to optimize LLW/MLLW disposition. The NDS will be developed in two phases. This document examines specific DOE sites with a significant quantity of Environmental Management (EM) LLW/MLLW, namely: Oak Ridge, Savannah River, Idaho, Hanford, Portsmouth and Paducah. The NDS will consider LLW/MLLW disposal from the present to FY 2035. Subsequently, the NDS will be expanded to examine the LLW/MLLW streams from all U.S. Department of Energy (DOE) sites.

Formerly, each DOE site determined the disposal options for its own LLW and MLLW and, to a large degree, site specific waste management plans had not been fully integrated within a complex-wide baseline. However, there is increasing Congressional interest in how DOE manages its LLW/MLLW, specifically regarding the life-cycle cost of waste disposal. Congress recently requested the U.S. Government Accountability Office (GAO) to determine whether DOE sites use life-cycle cost analysis to evaluate LLW treatment and disposal options. The GAO was also requested to determine if the Department has a complex-wide strategy for cost effectively managing LLW disposal. In 2005, the GAO published a report criticizing the Department for not conducting life-cycle cost analyses for LLW/MLLW treatment and disposal ¹. In addition to the Congressional impetus, recently stakeholder organizations, such as the National Governor's Association, have called for a "national forum" and "formal integration" of DOE waste management plans. In addition to the external drivers, a complex-wide waste disposition strategy will allow the Department to integrate site waste disposition plans to find cost efficiencies as well as to assist with the disposal of MLLW streams with no current disposal path, referred to as "To Be Determined" (TBD) waste streams.

In order to conduct the necessary analysis for this strategy, EM developed a new complex-wide LLW and MLLW database. New data requirements were developed in conjunction with waste managers and the data was collected in November 2005. Updated inventory quantities and inventory estimates were collected as well as a revised life-cycle projection. This data was used to create DOE LLW/MLLW disposition maps. These maps were then used to conduct a gap analysis to identify potential bottlenecks in disposal capacity. The gap analysis confirms that adequate capacity currently exists at both commercial and federal disposal facilities for the Department's LLW. However, the Nevada Test Site's (NTS) MLLW disposal facility will close by November 2010. After this date, the Department may have to consider other commercial or federal disposal options. There are a number of TBD MLLW streams identified, which are listed in Appendices D through H. The inventory in these tables is dynamic as efforts continue at the various sites to define the appropriate disposal paths for these streams.

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DOE's goal is to provide strategic direction to ensure safe disposition and, where possible, reduce treatment and disposal costs. However, the Department lacks a consistent complex-wide basis to quantify these costs. The NDS qualitatively discusses the life-cycle cost analysis of LLW/MLLW disposition and recommends the development of a consistent Department-wide methodology for conducting life-cycle cost analyses of waste treatment and disposal options.

The pre-disposal costs (e.g., waste handling, storage, characterization, preparation, packaging, and transportation) can be significantly greater than the costs charged by a disposal facility. High pre-disposal costs are normally associated with the more complex, higher activity wastes and mixed waste streams, such as those disposed of at NTS and Hanford, as well as certain LLW that requires stabilization before disposal. Additionally, modifying disposal decisions or injudicious disposition planning can produce extended storage, re-handling, and repackaging, thereby significantly increasing pre-disposal costs. Therefore, it can be concluded that pre-disposal costs may represent significant life-cycle cost savings opportunities. Unit pre-disposal costs are strongly influenced by the radioactive constituents in the waste, the physical form of the waste, the origin of the waste, its point of generation relative to its disposal destination, and the volume of waste. These factors can result in a substantial range of pre-disposal costs.

Life-cycle cost, although significant, is not the sole factor to consider when making a waste treatment/disposal decision. Technical risk, worker protection, and schedule are other essential factors that must be considered. Consideration of all factors may result in the selection of a more expensive waste disposal pathway that achieves a superior benefit. Although understanding the life-cycle costs associated with waste treatment and disposal is important, cost should not be the sole consideration.

As part of life-cycle waste planning, the Department has methods to reduce the amount of radioactive waste for disposal. For example, under the Department's radiation protection requirements, it is possible to release very low activity materials from radiological controls for restricted or unrestricted use. For the disposal of waste, this can result in more appropriate and economical disposal as well as minimizing the amount of LLW requiring disposal. Restricted release of waste materials from radiological controls, in consultation with appropriate regulatory authorities, has allowed for cost-effective waste disposal in non-radiological landfills while protecting human health and the environment. Further opportunities to use restricted release could reduce DOE's waste disposal life-cycle costs.

Conclusions

- Overall, adequate disposal capacity exists to meet near term needs. There is currently adequate capacity using DOE and commercial Treatment, Storage and Disposal Facilities (TSDF's) for the bulk of the Department's LLW and MLLW. However, the NTS MLLW disposal facility will close by November 2010. After that date, the Department may have to consider other federal and commercial disposal options.

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- The long term availability of disposal capacity for higher-activity MLLW poses a significant risk and will have to be monitored closely. For example, limited disposal capacity exists for MLLW with transuranic (TRU) radionuclide concentrations between 10 and 100 nCi/gm. Only NTS and Hanford have regional disposal facilities that can accept this waste from other DOE sites and off-site waste cannot currently be disposed of at Hanford. The NTS MLLW disposal facility will close by November 2010. Consequently, the disposal path for this higher activity MLLW beyond that date remains uncertain.
- The Department benefits from the existence of multiple disposal sites, both federal and commercial, which provide disposal alternatives. The management of the Department's LLW/MLLW disposition is a complex undertaking that requires flexibility. The waste management system must be agile and able to respond to sudden changes and dynamic circumstances. Therefore, it is advisable to foster as many federal and commercial treatment/disposal alternatives as economically feasible in order to promote competition.
- Life-cycle cost is not the only factor to consider when selecting a LLW/MLLW treatment or disposal path. Technical risk, worker protection, and schedule adherence are other essential factors. Therefore, LLW/MLLW life-cycle costs should not be the sole consideration.
- The LLW/MLLW predisposal costs may represent significant life-cycle cost savings opportunities.

Recommendations

- Identify cost data requirements. Identify the specific waste treatment and/or disposal cost data that should be monitored at a complex-wide level. For example, estimates of future waste volumes, particularly within Deactivation and Decommissioning (D&D) projects, are often inaccurate. Accurate waste characteristics, volume, and, correspondingly, cost projections, will assist waste management disposition planning and subsequent decision-making. Consequently, the Department may consider the development of a predictive cost model.
- Develop and implement guidance for LLW/MLLW life-cycle disposition cost analyses. The GAO's review found inconsistent application of the existing guidance for life-cycle costing among EM projects. Some of the inconsistency was due to a lack of detail and clarity in the original guidance issued in 2002. Therefore, the existing guidance should be reviewed and a schedule developed to revise the life-cycle cost guidance for LLW/MLLW disposition decisions. Consideration will be given to the GAO's specific recommendation to include specific requirements in contracts.

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- Maintain and formalize coordination with the commercial LLW/MLLW treatment and disposal industry. Maintain and enhance communication channels with the commercial radioactive waste treatment and disposal industry in order to improve partnering and to identify the most cost effective treatment/disposal alternatives.
- Review all existing site contracts and waste-related subcontracts to identify requirements related to waste disposal and life-cycle cost analysis. Following this review, specific contract actions to improve LLW/MLLW management activities may be recommended.
- Increase the use of methods such as authorized limits where appropriate to release waste from radiological controls prior to disposal. The expanded use of authorized limits can result in significant cost savings and radiological waste minimization while protecting the health and safety of workers, the public and the environment.

Introduction

The DOE EM program is committed to the environmental remediation of DOE sites throughout the nation. Central to this mission is the restoration of contaminated sites from nuclear weapons research and production and the disposal of the resulting radioactive and hazardous wastes. In the process, the Department seeks to reduce risk and minimize lifecycle costs. Facility D&D and the environmental restoration of contaminated sites generate large amounts of LLW and MLLW, as well as High Level Wastes, TRU wastes and hazardous wastes. This DOE National LLW/MLLW Disposition Strategy (NDS) discusses the Department's long-range strategy for managing and dispositioning its LLW and MLLW. This strategy is consistent with the DOE Strategic Plan ². Among the goals in that plan is to clean up the Department's nuclear weapons manufacturing and testing sites. This Strategy is also consistent with DOE Order 435.1, *Radioactive Waste Management* ³ and the corresponding DOE Manual 435.1-1, *Radioactive Waste Management Manual* ⁴, which requires a waste management strategy to integrate waste projections and life-cycle waste management planning into complex-wide decisions for LLW and MLLW.

Background

LLW can be segmented into waste categories of Class A, Class B, Class C and Greater-Than-Class C (GTCC). These classifications are defined in the Nuclear Regulatory Commission (NRC) regulations (Title 10, Code of Federal Regulations [CFR], Part 61),

Low-Level Waste is unique among radioactive wastes in that it is defined by what it is not. LLW is defined as radioactive waste that is not high-level waste, spent fuel, transuranic waste, byproduct material (as defined in section 11 (e)2 of the Atomic Energy Act of 1954, as amended), or naturally occurring radioactive material.

based on potential LLW hazards and disposal and waste form requirements. It is important to note that these classifications generally apply to commercial LLW, i.e. NRC regulated LLW, and not DOE LLW. However, the classifications are relevant when DOE sends its waste to a commercial facility (which is regulated by NRC) for disposal. The NRC regulations establish four classes of commercial low-level waste, based on the concentration of specific radionuclides. Class A waste contains the least radioactivity, most of which comes from relatively short-lived radionuclides, which decay to background levels within a few decades. Class B waste is also relatively short-lived, but contains higher concentrations of short-lived radionuclides than Class A. Class C waste can contain higher concentrations of both short-lived and long-lived radionuclides, while GTCC is higher still.

Three classes, A, B, and C, are considered suitable for shallow land burial, while a fourth class, "Greater-Than-Class C" (GTCC), requires different and, in general, more stringent disposal methods. While the states and regional disposal compacts are responsible for disposal of Class A, B and C LLW, the Federal Government, i.e., DOE, is responsible for providing a disposal facility for commercial GTCC waste. The

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Department is currently engaged in a process that will ultimately provide a disposal option for GTCC waste. Appendix A discusses the status of the GTCC effort. Because the Department has not reached a decision on GTCC waste disposition, this category of waste is not discussed further in the NDS.

Sealed sources are considered to be a subset of DOE LLW. Non-transuranic DOE sealed sources are being disposed of at DOE LLW facilities and the transuranic DOE sealed sources with a defense pedigree are being disposed of at the Waste Isolation Pilot Plant (WIPP) consistent with the WIPP Waste Acceptance Criteria (WAC). DOE transuranic sealed sources that lack a defense pedigree will be analyzed as part of the GTCC Environmental Impact Statement (EIS).

EM generates and manages the vast majority of the Department's LLW/MLLW through the remediation of former weapons production sites. Accordingly, EM has the lead responsibility within the Department for developing and implementing waste management policy. Other Departmental programs generate lesser volumes of LLW and MLLW through mission activities and are involved in these efforts. The following documents define the framework of the Department's waste management program:

- *The Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage and Disposal of Radioactive and Hazardous Waste (EIS-0200)*⁵ was published in 1997. Records of Decision (ROD) related to LLW/MLLW treatment and storage disposal paths were subsequently published in 2000. These National Environmental Policy Act (NEPA) documents provide the planning framework for LLW/MLLW management within the complex.
- DOE Order 435.1, *Radioactive Waste Management*³ was published in 1999, and subsequently modified in 2001. A guide, DOE Guide 435.1-1, *Implementation Guide for use with DOE M 435.1-1*⁶, and manual, DOE Manual 435.1-1, Change 1, *Radioactive Waste Management Manual*⁴, accompany the order and define specific requirements related to LLW/MLLW management. This body of documents defines the technical and regulatory framework for all LLW/MLLW activities within the Department, including disposition planning and reporting. For LLW/MLLW, DOE Manual 435.1-1, pages I-8 and I-9, establishes a preference for on-site disposal, when feasible, and off-site shipment to one of the Department's regional disposal sites, when on-site disposal is not feasible. The order includes an exemption process for use of off-site commercial disposal facilities when sites can determine that it is more cost-effective to do so and demonstrate that commercial disposal is in the best interest of the Department.
- In 2000, the Department released the Central Internet Database (CID) to the public, as required by the 1998 Programmatic Environmental Impact Statement (PEIS) Settlement Agreement between the Department and the Natural Resources Defense Council. The CID contained information on contaminated environmental media, facilities and wastes managed by the EM program. The

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CID provided a snap-shot of EM's waste management scope as of the late 1990's, which included large stores of legacy LLW.

Objective

The NDS provides a complex-wide program plan for LLW/MLLW management and designs a complex-wide strategy for the safe and effective treatment, storage and disposal of the Department's LLW and MLLW. This strategy is a framework to evaluate various disposition options, to include identifying gaps or potential bottlenecks in the capability or capacity of TSDF's. Furthermore, this strategy addresses those MLLW streams without a current treatment or disposal path, referred to in this document as TBD waste streams. The NDS also discusses the conduct of life-cycle cost analysis for LLW/MLLW disposition.

The NDS will be developed in two phases. This document examines specific DOE sites with a significant quantity of EM LLW/MLLW, namely: Oak Ridge, Savannah River, Idaho, Hanford, Portsmouth and Paducah. The NDS will consider LLW/MLLW disposal from the present to FY 2035. Subsequently, the NDS will be expanded to examine the LLW/MLLW streams from all DOE sites.

Resources Currently Available for the Treatment and Disposal of Departmental Low-Level and Mixed Low-Level Waste

The DOE produces LLW and MLLW at a number of sites throughout the country, as illustrated in Figure 1. Departmental policy, as expressed in DOE Manual 435.1-1⁴, is that DOE LLW/MLLW will be disposed of at the site where generated whenever feasible. Several of these DOE sites do have the capability to dispose their LLW at their own on-site burial grounds. For example, Oak Ridge disposes waste from Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) remedial actions at its Environmental Management Waste Management Facility (EMWMF), an on-site CERCLA disposal facility. As another example, the Idaho National Laboratory (INL) operates two disposal facilities. An active shallow-land-burial area for the permanent disposal of solid low-level waste is located at the Subsurface

Remote-handled waste is packaged waste whose external surface dose rate exceeds 200 mrem per hour. In order to minimize dose exposure to the workers, these waste packages are manipulated via automated equipment, i.e. remotely.

Disposal Area of the Radioactive Waste Management Complex (RWMC). The burial area includes disposal of remote-handled low-level waste in concrete vaults. The Low-Level Waste Disposal Facility at the RWMC is scheduled to stop receiving contact handled LLW in 2008 and close in 2009. The Department is currently evaluating the disposal options for both on-

site and off-site disposal of INL Site LLW after the Subsurface Disposal Area (SDA) closes. The second INL disposal facility, the INL CERCLA Disposal Facility (ICDF) disposes of soil and debris from CERCLA cleanup operations and is located southwest of

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the Idaho Nuclear Technology and Engineering Center (INTEC). This disposal facility was part of the remedy for cleanup of contaminated soils and debris from INTEC and other INL facilities. The ICDF consists of a landfill, lined evaporation ponds and treatment, storage and administration facilities.

For a list of LLW and MLLW streams that will go off-site for treatment or disposal, to include TBD waste streams, refer to Appendices D through H.

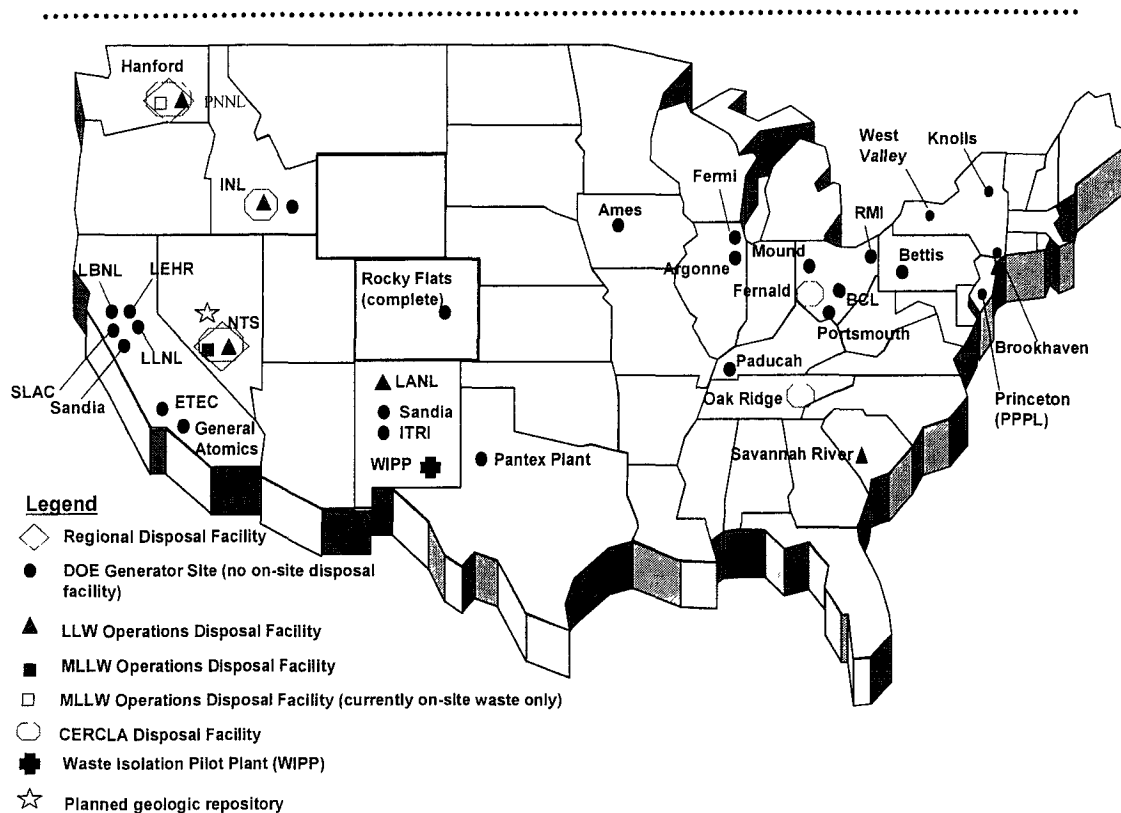


Figure 1 DOE's Waste Producing Sites and Disposal Facilities

DOE Regional Treatment and Disposal Sites

Only two DOE sites, Hanford and the NTS, have accepted significant LLW quantities from other DOE sites*. Currently, Hanford is not accepting waste (LLW, MLLW or TRU waste) from other DOE sites pending the completion of the Tank Closure and Waste Management EIS and the publication of the appropriate RODs. This restriction is based upon a Settlement Agreement with the State of Washington and does have a few exceptions, e.g., certain Naval waste is allowed to be imported. The Toxic Substances

* The Los Alamos National Laboratory can accept off-site LLW for burial; however it is limited by permit to accept no more than 5 m³.

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Control Act Incinerator (TSCAI) at the Oak Ridge ETTP is the only remaining DOE facility capable of incinerating MLLW and, as such, is a unique DOE asset.

Nevada Test Site (NTS)

The NTS is a DOE National Nuclear Security Administration Nevada Site Office facility. The site is approximately 1,375 square miles and is larger than the state of Rhode Island. Established in 1950 as the Atomic Energy Commission's proving ground for nuclear weapons testing, the site is located approximately 65 miles north of Las Vegas in the Great Basin desert. The facility is surrounded on three sides by federally owned and controlled land.

Low-level waste is accepted for disposal from on and off-site DOE generators. Further, classified low-level material is accepted for storage in a disposal-like manner from on and off-site DOE and Department of Defense (DoD) generators. Prior to waste acceptance, generators undergo a rigorous certification and acceptance process, which includes demonstrating compliance with the Nevada Test Site Waste Acceptance Criteria (NTSWAC). The NTSWAC provides the requirements for the generator waste certification program, characterization, traceability, waste form, packaging, and transfer. The NTSWAC can be found at:

(<http://www.nv.doe.gov/programs/RadioactiveWasteAcceptance.htm>).

Two radioactive waste disposal facility areas at the NTS are discussed below:

The **Area 5 Radioactive Waste Management Site (RWMS)** is a 732-acre facility (160 acres currently used for disposal) located north of Frenchman Flat (southeast corner of NTS). The facility started operations in 1961 and began accepting off-site waste in 1976. LLW is disposed in excavated trenches and pits, ranging in depth from 12 to 48 feet. The area has a depth to groundwater of approximately 800 feet. The facility has a Mixed Waste Disposal Unit regulated both by the DOE and by the State of Nevada. Per agreement with the State, this MLLW unit will operate under Resource Conservation and Recovery Act (RCRA) interim status until closure, and will be closed either in November 2010 or when it reaches the maximum capacity of 20,000 m³. Should the Department wish to dispose of MLLW at NTS after this unit closes, an entirely new facility will have to be permitted and constructed. The amount of MLLW disposed (as of Feb. 2006) at the RWMS is 8,500 m³.

As of February 2006, more than 386,000 m³ of LLW have been disposed at the Area 5 RWMS. Calculations based on existing inventory show that there is nearly 3 million m³ of remaining capacity in the existing 732 acres (including the developed 160 acres). The facility has the capability of easily expanding disposal operations to accommodate additional volumes of LLW.

The **Area 3 RWMS** is the second LLW disposal facility at the NTS. The 120-acre facility is located in Yucca Flat. Disposal operations at the facility began in 1968. Waste disposed at the Area 3 RWMS was placed in subsidence craters formed by historical

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underground nuclear weapons tests. The area has a depth to groundwater of approximately 1,600 feet. As of March 2005, more than 550,000 m³ of LLW have been disposed in the facility. The Area 3 RWMS was placed into cold standby in June 2006, i.e. the unit will no longer accept waste. The NTS will place a Closure Cap on the Area 3 RWMS by 2011.

Hanford Site

The Hanford Site was established in 1943 as part of the World War II nuclear weapons production effort. It occupies 586 square miles in southeastern Washington State (north of and adjacent to Richland, Washington). Disposal of solid LLW and MLLW currently occurs at two locations – the Low Level Burial Grounds (LLBG's) and the Environmental Restoration and Disposal Facility (ERDF). Both facilities are on the Hanford Site's Central Plateau, as is the commercial LLW disposal facility operated by US Ecology. There are other burial grounds throughout the Hanford Site, but they are no longer in operation.

The LLBG's comprise eight specific burial grounds. They started operation in the 1960's and cover about 1,050-acres, portions of which have never been used. Over 280,000 m³ have been disposed in the LLBG's. Solid LLW and MLLW from onsite and offsite generators have historically been disposed in the LLBG's. As a result of the Hanford Solid Waste EIS ROD ⁷, disposal of solid LLW and MLLW has been limited to two RCRA-compliant (i.e., double-lined trench with leachate collection system) mixed waste trenches within the LLBG's. There is an exception for naval reactor compartments which were subject to previous National Environmental Policy Act (NEPA) decisions. As of January 2006, the mixed waste trenches have about 17,000 m³ remaining capacity from an original capacity of approximately 22,300 m³.

As mentioned above, the Department is preparing the Tank Closure and Waste Management EIS. Until this document is published, and the appropriate RODs issued, receipt of solid LLW and MLLW from offsite generators for disposal is suspended (with some exceptions). Information on the Hanford Site "Solid Waste Acceptance Program" and its WAC can be accessed at:

<http://www.hanford.gov/wastemgt/wac/index.cfm>

The ERDF is authorized by the U.S. Environmental Protection Agency (EPA) under CERCLA and is only available for disposal of waste generated from the cleanup of the Hanford site. The ERDF meets RCRA design requirements (e.g. double-lined with leachate collection) for disposal. The ERDF is a modular facility of which two cells (#1 and 2) are full, two cells (#3 and 4) are nearly full, disposal has started in two more cells (#5 and 6), and the construction of two more cells (#7 and 8) is planned for FY 2007.

A new disposal facility, the Integrated Disposal Facility (IDF), located in the 200 East Area, will consist of an expandable lined landfill with a combined capacity of 900,000 m³. The landfill will consist of two distinct cells, one for LLW and the other for MLLW. The low level radioactive waste cell is regulated by DOE under the Atomic Energy Act

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(AEA) and DOE Order 435.1, *Radioactive Waste Management* ³. The RCRA mixed waste cell is regulated by DOE under DOE Order 435.1 and by the State of Washington, Department of Ecology, under RCRA. DOE submitted an IDF RCRA permit application to the Washington Department of Ecology in 2004 for disposal of on-site and off-site generated mixed waste including vitrified Immobilized Low Activity Waste (ILAW), spent melters and/or other bulk mixed waste. DOE issued a Hanford Solid Waste EIS ROD ⁷ in 2004 which would have allowed for the IDF construction and operation as described in the RCRA permit application. However, the State of Washington Department of Ecology maintained that the EIS was inadequate to meet State Environmental Policy Act (SEPA) requirements and consequently declined to issue the RCRA permit to commence construction. To resolve this regulatory impasse, DOE agreed to revise the RCRA permit application and limit waste receipt in the RCRA cell to vitrified ILAW waste generated in the Waste Treatment Plant (WTP) from the treatment of Hanford tank waste. The agreement also included the disposal of fifty containers of vitrified bulk ILAW generated from a Supplemental Treatment Projects Demonstration Bulk Vitrification System. Based on this permit application revision, the Department of Ecology has authorized the IDF construction through a series of temporary authorizations prior to permit issuance. Phased construction of 165,000 m³ of combined cell capacity is scheduled for completion in the summer of 2006 with commencement of disposal activities subject to the issuance of a final RCRA permit. Once the SEPA issues are resolved with the Department of Ecology, DOE will seek a RCRA permit modification to address receipt of the other waste forms that were contemplated in the original RCRA permit application. There are no issues related to the geology of the IDF. Disposal of onsite LLW in the IDF LLW cell is not affected by the RCRA permit conditions.

Toxic Substances Control Act Incinerator (TSCAI)

The TSCAI located on the East Tennessee Technology Park (ETTP) Site in Oak Ridge, Tennessee is DOE's only treatment alternative for radioactive wastes that require incineration. It provides cost-effective treatment for radioactively contaminated PCB wastes and also provides for treatment of MLLW requiring thermal treatment. It enables other DOE sites to meet their Site Treatment Plan and Federal Facilities Compliance Act milestones, as well as their accelerated clean-up schedules. Current plans have scheduled TSCAI operations until 2009. Beyond that date, its future is uncertain, and will be determined based on the inventory of wastes still needing thermal treatment and the availability of cost effective alternative treatment methods.

Low-Level and Mixed Low-Level Waste Commercial Disposal Market

Were all the DOE disposal sites discussed above available indefinitely to accept DOE LLW and MLLW, the Department would be self-sufficient in disposal, if not treatment, capability. However, as noted above, the Hanford site is currently unable to accept waste from off-site generators and the NTS MLLW facility will cease operations by November 2010. In addition, it may often be less costly to dispose of waste at a commercial facility than a DOE site. Consequently, it is essential that the Department continue to partner

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with the commercial TSDF's in order to allow the most cost-effective and efficient LLW/MLLW disposal. There are currently three commercial disposal facilities that can accept DOE LLW and an additional facility that may become available. The licensed capabilities of these facilities differ and are explained below.

DOE Consolidated Audit Program

Before DOE can use a commercial TSDF, the Department must be assured of the adequacy of the vendor. DOE policy, as stated in DOE Manual 435.1-1, Radioactive Waste Management Manual⁴, is that DOE radioactive waste shall be treated, stored, and in the case of LLW, disposed of, at the site where the waste was generated, if practical, or at another DOE facility. If DOE capabilities are not practical or cost effective, the DOE Field Office Manager may grant an exemption to use a non-DOE facility for the storage, treatment or disposal of DOE radiological waste. For such an exemption to be granted, the non-DOE facility must comply with all Federal, State and local requirements, possess the necessary permits, and be determined by the field office manager to be acceptable based on a review conducted annually by the DOE. Exemptions for the use of non-DOE facilities shall be documented to be cost effective and in the best interest of the Department, to include consideration of life-cycle cost and potential liability. Before the exemptions for disposal take effect, DOE-HQ is notified and the Office of Environment, Safety and Health is consulted. In addition, host states and state compacts where the commercial TSDF is located shall be consulted prior to the approval of the exemption and notified prior to the waste shipment.

DOE Guide 435.1-1, Implementation Guide for use with DOE M 435.1-1⁶, elaborates on the above policy. The Guide explicitly encourages DOE sites to seek the most practical disposal option, especially if there is a lower cost alternative. However, the Guide states that it is the responsibility of a DOE organization using a non-DOE facility to ensure, on an annual basis, that the facility is maintaining an acceptable performance record, either through their review or through review by another DOE organization or contractor.

To avoid redundant audits of commercial TSDF's servicing multiple DOE customers, the Department instituted the DOE Consolidated Audit Program (DOECAP). The DOECAP is administered by the Office of Environment, Safety and Health (EH), Office of Quality Assurance Programs (EH-31). In addition to eliminating redundant audits, the DOECAP standardizes auditor qualifications and audit methodology. This standardized audit process ensures DOE accountability for LLW and MLLW at commercial TSDF's. The audits consist of seven subject areas: Quality Assurance Management Systems, Sampling and Analytical Data Quality, Waste Operations, Environmental Compliance/Permitting, Radiological Control, Industrial and Chemical Safety, and Transportation Management.

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EnergySolutions[†]

Since 1988, EnergySolutions, formerly known as Envirocare of Utah, has operated a 540-acre disposal facility at Clive, Utah, about 80 miles west of Salt Lake City. The site was established adjacent to an area formerly used by the DOE for the disposal of uranium mill tailings. Much of the waste disposed at the EnergySolutions Clive Facility comes from the cleanup of commercial and government facilities. The disposal site currently contains approximately 4,200,000 cubic meters (m³) total combined volume of Class A equivalent waste, 11e.(2) material, Naturally Occurring Radioactive Material (NORM), and MLLW. The facility has additional capacity for more than 20 years of operation.

The Utah Department of Environmental Quality (DEQ) has licensing and regulatory authority for the EnergySolutions Clive Facility. Utah originally approved the site to accept NORM. Since then, the license has been amended multiple times to allow more types of radioactive waste, including LLW. EnergySolutions has a RCRA Part B Permit from the Utah Division of Solid and Hazardous Waste which allows operation of a separate MLLW disposal cell. EnergySolutions received a Toxic Substances Control Act (TSCA) Coordinated Approval from the EPA for disposal of certain polychlorinated biphenyl (PCB) radioactive waste and PCB mixed waste. In addition, the Clive Facility has several treatment capabilities to treat MLLW prior to disposal, including waste with heavy metal and organic contamination including PCB's. Depending upon the applicable waste treatment standards or disposal requirements, EnergySolutions can either directly dispose without further treatment or dispose following treatment. EnergySolutions is permitted for onsite treatment including macroencapsulation, liquid solidification, chemical stabilization or its Vacuum Thermal Desorption (VTD) process. The VTD condensate byproduct from approved DOE wastes can either be stored or incinerated at the TSCAI.

US Ecology, Richland, Washington Site

US Ecology, a subsidiary of American Ecology Corporation, operates the Richland facility, a 100-acre radioactive waste disposal facility located within the DOE Hanford site. This facility is sub-leased from the State of Washington (a member of the Northwest Compact), on land leased from the Federal government. The Richland facility only accepts Class A, B and C LLW generated within the Northwest Compact and, under an agreement between compacts, the Rocky Mountain Compact[‡]. However, regardless of the state of origin, the US Ecology Richland facility may accept radioactive material exempt from NRC regulation as well as Naturally-Occurring or Accelerator-Produced Radioactive Material (NARM) since such materials are not governed by the compact. The Richland facility has unused LLW capacity of approximately 600,000 m³. To date,

[†] EnergySolutions was formerly known as Envirocare of Utah. This company recently acquired BNG America and Scientech D&D and changed the company's name to EnergySolutions. EnergySolutions is currently in the process of acquiring Duratek.

[‡] The Northwest Compact comprises of the states of Alaska, Hawaii, Idaho, Montana, Oregon, Utah, Washington, and Wyoming. The Rocky Mountain Compacts consists of the states of Colorado, New Mexico and Nevada.

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the facility has disposed of approximately 400,000 m³ of LLW in 20 trenches. About 95% of the waste is Class A LLW.

The State of Washington Department of Health exercises primary regulatory responsibility over US Ecology's Richland disposal facility. It licenses the facility operator and regulates radioactive material. A Department of Health inspector examines each shipment of waste prior to disposal. The Department of Ecology has primary program responsibility as the host state for the Northwest Compact. It issues individual permits for radioactive waste disposal to generators and serves as the site landlord. Furthermore, the Department of Ecology administers dedicated funds set aside for closure and post-closure care.

US Ecology, Grand View, Idaho Site

US Ecology owns and operates a hazardous and PCB waste disposal facility at Grand View, Idaho that disposes of high volumes of waste containing residual amounts of radioactive material (exempt quantities not requiring an NRC disposal license). The facility is located on a 1,300-acre site 65 miles southeast of Boise. High volume throughput is supported by US Ecology's rail transfer station 35 miles north of the site. While the Grand View facility cannot accept most LLW, it has disposed of more than 750,000 tons of low activity waste. Permitted radioactive wastes are limited to 2,000 picocuries per gram, and may include RCRA mixed waste as well as fission and activation products. The Grand View facility also treats and disposes mixed waste that includes organic, inorganic, PCB and radioactive constituents.

Barnwell Disposal Facility

The Barnwell disposal facility, located in Barnwell, South Carolina, was opened in 1969, with the license for shallow burial of Class A, B and C LLW issued in 1971. Chem-Nuclear Systems has operated the Barnwell facility since it opened. In 2000, Chem-Nuclear Systems became a subsidiary of Duratek Inc.[§] This commercial disposal site is located near the DOE Savannah River Site (SRS). In 1976 the site was expanded to its present size of 235 acres with a capacity of approximately 870,000 m³ for all classes of radioactive waste. The South Carolina Department of Health and Environmental Control has the licensing and technical regulatory authority for the Barnwell facility. The State of South Carolina is the site owner and a member of the Atlantic Compact^{**}.

The Barnwell disposal facility is nearing current capacity. About 102 of the 235 acres of the site have been filled, with about 13 acres remaining for disposal. There are about 75,000 m³ of space remaining. However, most of this space has been reserved for the decommissioning of 12 nuclear power plants in the Atlantic Compact. In addition, the facility will be closed to out-of-compact waste by July 1, 2008.

[§] EnergySolutions is in the process of acquiring Duratek, Inc. The transaction is subject to regulatory approval.

^{**} The Atlantic Compact consists of Connecticut, New Jersey and South Carolina.

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Waste Control Specialists LLC (WCS)

The Waste Control Specialists (WCS) facility is located 30 miles west of Andrews, Texas. At present this 1,338-acre facility is licensed to treat (e.g. stabilize), process and store LLW and MLLW, including GTCC LLW, PCB's, special nuclear material and sealed sources. The facility also disposes of certain wastes containing residual quantities of radioactive material subject to conditions of its RCRA permit.

WCS has a license application pending before the Texas Commission on Environmental Quality (TCEQ) for near-surface land disposal of Class A, B and C MLLW. Pursuant to Texas law (House Bill 1567), TCEQ must rule on the WCS license application no later than December 2007. This application includes a 30-acre facility for the initial disposal of 76,460 m³ of a possible total of 917,520 m³ of LLW generated within the Texas Compact^{††} and an adjacent, separate and distinct 100-acre facility for disposal of up to 4.6 million m³ of Federal LLW and MLLW no later than December 2007. The regulations require that before accepting Federal facility waste, a written agreement must be signed by the Secretary of Energy stating that the Federal government will assume all rights, title, and interest in land and buildings for the disposal of Federal facility waste, together with requisite rights of access to the land and buildings. No such agreement has been made at this time because the Department has not yet made a policy decision regarding the use of this potential new facility.

WCS also has a license application pending before the Texas Department of State Health Services (TDSHS) for near surface land disposal of approximately 781,200 m³ of 11e.(2) byproduct material in a separate and distinct facility.

Commercial Vendor Matrix

Table 1 summarizes the above commercial vendor information and lists contract vehicles currently available complex-wide. Table 2 provides more information on those contracts with the *EnergySolutions* Clive Facility available for use complex-wide. The costs in Table 2 are as of Sept. 2005.

The Corps of Engineers has a contract with WCS to dispose of low activity waste that is exempt from NRC and the State of Texas (NRC Agreement State) jurisdiction and they have routinely shipped such waste to WCS. This contract is available for use by DOE.

^{††} The Texas Compact consists of the States of Texas and Vermont.

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Table 1

Commercial LLW/MLLW Disposal Facilities

Commercial Vendor	Location	Radioactive Waste Accepted	Restrictions	Contract Vehicles
Energy Solutions	Clive, UT	Class A LLW, MLLW & 11e(2) byproduct material	Cannot accept Class B & C LLW or sealed sources.	Complex Wide: <ul style="list-style-type: none"> • Chicago Operations Office • Oak Ridge Broad Spectrum (MLLW only) • Ohio (LLW only) Plus various subcontracts with various DOE sites.
US Ecology	Richland, WA	Class A, B & C LLW, NARM and NRC-exempt	Cannot accept MLLW. LLW limited to the Northwest and Rocky Mountain compact states.	Army Field Service Command
	Grand View, ID	Low activity ^{††} LLW, MLLW and NARM	Limits in RCRA permit.	Army Corps of Engineers
Duratek	Barnwell, SC	Class A, B & C LLW	Cannot accept MLLW or 11e(2) byproduct material	Duratek has contracts and subcontracts at most DOE sites.
Waste Control Specialists (WCS)	Andrews, TX	Low activity LLW. Licenses pending to accept 11e.(2) byproduct material and Class A, B & C LLW/MLLW	Limits in RCRA permit. Currently no disposal capability for MLLW and most LLW.	Oak Ridge Broad Spectrum Army Corps of Engineers

^{††} Low activity waste refers to waste containing residual quantities of radioactive material that meets DOE requirements for release, i.e. no longer requires continued management under radiological control.

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Table 2

EnergySolutions, Clive Facility, Disposal Contracts Available Complex-Wide

Contract Site	Contract Number	Expiration Date	Cost	Comments
Chicago	AM02-02CH11136	Sept. 2007	\$1,403/yd ³ (\$1,835/m ³)	MLLW Soil-like Disposal
			\$1,876/yd ³ (\$2,454/m ³)	MLLW Debris-like disposal
			\$2,820/yd ³ to \$4,679/yd ³ (\$3,688/m ³ to \$6,120/m ³)	MLLW microencapsulation The cost varies depending upon the type of the container.
Oak Ridge	AC05-04OR22693	May 2009	\$415/yd ³ (\$317/m ³)	MLLW Soils, disposal only.
			\$632.88/yd ³ (\$484.08/m ³)	MLLW Debris, disposal only
Ohio	AM24-98OH20053	June 2008	\$148/yd ³ (\$194/m ³)	LLW Soils, disposal only
			\$405/yd ³ (\$530/m ³)	LLW Debris, disposal only

The Department has three contract vehicles with EnergySolutions, pertaining to their Clive Facility, which are available through: 1.) the DOE Ohio Field Office, 2.) the Oak Ridge Operations Office or 3.) the DOE Chicago Office. In addition, EnergySolutions has approximately 23 direct contracts with DOE contractors, as these contractors will often enter into arrangements when special handling, treatment, transportation needs, etc., are necessary. For example, EnergySolutions' VTD unit at the Clive Facility did not

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exist at the time of the DOE Chicago mixed waste treatment procurement. Note that the EnergySolutions Clive, Utah facility can accept 11e.(2) byproduct material provided the activity levels do not exceed those of Class A LLW. Note also that the EnergySolutions Clive Facility does not accept sealed sources as these are specifically prohibited in their WAC.

At the Richland, Washington facility, US Ecology has a disposal contract with the U.S. Army Field Service Command that is available for use by the DOE. Unlike commercial LLW governed by the Northwest Compact, DOE wastes are not subject to monopoly pricing conditions and therefore are not rate controlled by the regulators. DOE LLW outside the eight state Northwest and Rocky Mountain Compact regions (WA, OR, AK, MT, ID, UT, HI, WY) cannot be accepted. NARM (including sealed radium sources) may be received from all fifty states. Pricing is negotiable.

At the Grand View, Idaho facility, US Ecology has a disposal contract with the Corps of Engineers for bulk disposal of low activity waste and mixed waste that is available for use by the DOE. This disposal contract, which contains pricing of \$71.50 per cubic yard (yd³) for low activity waste and \$97 per yd³ for mixed waste, was recently extended by the U.S. Army Corps of Engineers through 2009. Containerized and odd sized waste pricing is negotiable.

Mixed Low-Level Waste Commercial Treatment Market

There are a number of commercial vendors that are available to treat DOE radioactive wastes. A few of the more frequently used vendors are discussed below. There are also several additional LLW and MLLW vendors that can treat DOE waste streams, with the potential for new vendors adding to existing commercial capabilities. More complete listing of such vendors is available in several commercial directories and State Compact web sites. For example, the National Directory of Brokers and Processors (<http://www.bpdirectory.com/>) lists commercial vendor capabilities.

The services from some of the following vendors can be obtained through the DOE Oak Ridge Operations Office (DOE-OR) by the Materials Disposition and Recycling Basic Order Agreement (BOA), a DOE Complex-wide procurement vehicle. The BOA, a streamlined method to pre-approve vendors, was initially developed in 1999 for scrap metal recycling but can be used for LLW/MLLW treatment or disposal. Of the following MLLW treatment vendors listed below, the following participate in the Materials Disposition and Recycling BOA:

- Duratek
- StudsvikRACE
- WCS

In addition, an Oak Ridge site contractor, Bechtel Jacobs, has established a treatment contract, referred to as “Broad Spectrum”, with Perma-Fix and with WCS. The Broad Spectrum contract is available for use complex-wide. The Perma-Fix contract includes

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treatment of organic/PCB contaminated soils, sludges, and debris, labpacks, liquids and elemental mercury. The WCS contract includes treatment of inorganic contaminated soils, sludges and debris. Information on the Broad Spectrum contract can be found at: www.becteljacobs.com/bs_home.shtml.

Duratek Bear Creek Facility^{§§}

The Duratek Bear Creek Facility, located in Tennessee, offers a variety of LLW treatment services:

- Incineration,
- Metal recycling (Metal Melting),
- Metal decontamination,
- Lead recycling,
- Compaction,
- Sealed source encapsulation,
- Sorting/inspection of legacy waste,
- Wet waste processing,
- Aqueous liquids processing, and
- Classified shapes destruction.

Duratek participates in the DOE-OR Materials Disposition and Recycling BOA discussed above. Duratek also manages many site-specific contracts with DOE facilities. The U.S. Army Field Support Command manages a second national contract used by the DOE for waste transportation, processing and disposal.

Duratek recently received approval from the NTS as a certified generator, which allows for the profiling and shipment of DOE waste to the NTS. An NTS certified generator is a site that has implemented a program to meet the requirements of the NTS WAC. The adequacy of this program is then verified by an NTS audit. As a certified generator, Duratek has the capability to serve as a broker between NTS and other TSDF's.

Duratek also owns and operates the largest fleet of dedicated Type A and Type B shipping casks in the country. These casks are used extensively by the DOE for shipments of high activity waste to various TSDF's. Hittman Transport, a wholly-owned Duratek subsidiary, maintains over sixty tractor-trailers dedicated to the safe transport of radioactive materials. Other Duratek divisions are actively involved in decommissioning of nuclear power reactors, fuel pool cleanout and the rental/calibration/repair of radiological instruments.

^{§§} EnergySolutions is in the process of acquiring Duratek, Inc. The transaction is subject to regulatory approval.

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EnergySolutions^{***}

The EnergySolutions Clive, Utah facility was discussed above as a disposal site. This facility treats and/or solidifies MLLW & liquid radioactive waste prior to disposal using macroencapsulation and stabilization, in addition to PCB and organics removal using its VTD process. EnergySolutions treatment services can be procured through a Complex-Wide Indefinite Quantity Contract from the Chicago Operations Office.

Pacific EcoSolutions (PEcoS)

The PEcoS facility, located at Richland, Washington, offers treatment of LLW and MLLW. Low-level waste treatment and services include:

- Thermal treatment,
- Supercompaction,
- Sizing and cutting,
- Decontamination, and
- Waste verification for disposal site waste acceptance criteria.

Mixed low-level waste treatment and services include:

- Thermal desorption of organic constituents,
- Plasma furnace destruction of organic constituents,
- Supercompaction,
- Macroencapsulation,
- Neutralization,
- Stabilization, and
- Waste verification for disposal site waste acceptance criteria.

The facility can accept most kinds of waste under a RCRA Part B permit. There is currently no DOE-wide contract. DOE site contractors have been entering into direct procurements with PEcoS for waste treatment services.

Perma-Fix/Diversified Scientific Services (DSSI)

The Perma-Fix Diversified Scientific Services (DSSI) facility, located in Kingston, Tennessee, offers thermal treatment for liquid (e.g. organic) hazardous and MLLW. Wastes are combusted in a licensed mixed waste boiler to meet land disposal restriction criteria. The residue is then disposed of at an appropriately licensed and permitted disposal facility. DSSI is currently installing a thermal treatment unit that should be able

^{***} As noted above, Envirocare recently acquired BNG America and Scientech D&D and changed the company's name to EnergySolutions.

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to accept PCB contaminated waste streams up to 50,000 ppm. When licensed, this unit is planned to have full TSCA authorization.

Perma-Fix treatment services can be procured through the Oak Ridge Broad Spectrum contract or site contractors can enter into direct procurements for waste treatment services.

Perma-Fix/Materials & Energy Corp. (M&EC)

The Perma-Fix Materials and Energy Corporation (M&EC) facility, located at the East Tennessee Technology Park (ETTP), Oak Ridge, Tennessee, treats both organic and inorganic MLLW (including PCBs and mercury). All waste codes are accepted and the license encompasses most isotopes. The facility has a Nuclear Criticality Safety Evaluation (NCSE) limit of less than 350 grams of nuclear materials at the facility at any one time.

Perma-Fix can treat MLLW using either the Perma-Fix I or the Perma-Fix II process. During the Perma-Fix I process, after sorting and sizing, the waste goes to an in-drum mixing system and appropriate stabilization reagents are added. In the Perma-Fix II process, a steam-heated VTD unit separates the volatile waste components from the inorganic matrix materials. The desorbed RCRA organics are condensed as liquids for secondary treatment, e.g., combustion. Perma-Fix can also treat waste debris using physical extraction (e.g., scarification, grinding, spalling, and high pressure steam and water sprays) or chemical extraction (e.g., liquid-phase solvent extraction). In addition, the facility can treat mercury contaminated waste using an amalgamation stabilization process.

Perma-Fix treatment services can be procured through the Oak Ridge Broad Spectrum contract or site contractors can enter into direct procurements for waste treatment services.

Perma-Fix of Florida

Perma-Fix of Florida, a subsidiary of Perma-Fix Environmental Services, is located in Gainesville, Florida. The facility is licensed to store and treat most RCRA waste codes, TSCA regulated PCB waste and radioactive waste. Like the M&EC plant above, the Perma-Fix Gainesville facility has an NCSE limit of less than 350 grams of nuclear materials on the site at any one time. This facility can treat MLLW using the Perma-Fix I or Perma-Fix II process described above.

Waste Control Specialists

The WCS facility, located in Andrews County, Texas, was discussed above as a potential disposal site. WCS treats (e.g. reduction, oxidation, stabilization), processes and stores LLW and MLLW (including GTCC, PCBs, sealed sources, solids and liquids). The

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current hazardous waste treatment capabilities include consolidation, repackaging, and stabilization for a wide variety of RCRA and TSCA wastes. Storage capability includes pre-packaged and treated LLW and MLLW, including GTCC and sealed sources. WCS has no upper limit on the total number of grams of nuclear material allowed on-site at one time. The site's nuclear material limit is concentration based, not based on the total number of grams. WCS treatment services can be procured through the Oak Ridge Broad Spectrum contract, the DOE-OR Materials Disposition and Recycling BOA, or through direct procurement by DOE site contractors.

StudsvikRACE

The StudsvikRACE^{†††} waste processing facility, located in Memphis, Tennessee, is accessible by barge, rail and truck and offers:

- Dry Active Waste (DAW) sorting and processing,
- Decontamination and disposal of solids, debris, and large components,
- Bulk Survey for Release (BSFR) of debris with very low concentrations of radionuclides to a licensed Subtitle D landfill in Tennessee,
- Liquid stabilization,
- Compaction and other volume reduction services, and
- Large component disassembly and mechanical grit blast decontamination.

StudsvikRACE processes waste streams that include metals, soil, wood, resin, and liquids, and specializes in large contaminated components transported by barge, rail or truck. StudsvikRACE routinely accepts all types of NRC Class A material for processing, but they can not accept RCRA hazardous wastes. Contracts are usually directly with the DOE site contractors. StudsvikRACE can also be contracted through the DOE-OR by the Materials Disposition and Recycling BOA as discussed above.

Development of the Apparatus and Methodology to Integrate Complex-Wide Low-Level Waste and Mixed Low-Level Waste Management

The preceding section discussed the current DOE and commercial TSDF resources available. The Department clearly benefits from the existence of multiple disposal sites, both federal and commercial, which provide disposal alternatives. This section outlines the tools and methodologies that can be used to strengthen and integrate the Department's complex-wide management of LLW/MLLW treatment and disposal.

^{†††} StudsvikRACE was formerly known as Radiological Assistance, Consulting and Engineering, LLC (RACE)

Low-Level Waste/Mixed Low-Level Waste Treatment and Disposal Costs

The House Subcommittee on Energy and Water Development, Committee on Appropriations, has expressed concern regarding the Department's LLW disposal, particularly regarding the extent to which life-cycle cost analyses are considered in making disposition decisions. The point is that without a documented life-cycle cost analysis, the Department can not adequately judge between alternate disposal pathways for a given LLW/MLLW stream. The Committee identified these concerns in response to preliminary findings of the GAO review and subsequent report, "Department of Energy: Improved Guidance, Oversight and Planning are Needed to Better Identify Cost-Saving Alternatives for Managing Low-Level Radioactive Waste¹". Appendix B discusses the background for these concerns regarding the Department's use of life-cycle cost analyses in planning LLW/MLLW disposition.

The Department shares the Committee's concerns regarding cost effective LLW/MLLW disposition. Therefore, one of the principal objectives of the NDS is to determine the cost information and tools currently available and to identify future systems required to guide and monitor LLW/MLLW life-cycle cost analysis.

Although it is important to have an understanding of the costs associated with LLW/MLLW disposition, cost should not be the only factor to consider when selecting a treatment or disposal path. Technical risk, worker protection, and schedule adherence are other essential factors. Therefore, LLW/MLLW life-cycle costs should not be the sole consideration.

The Life-Cycle Cost Elements of Waste Disposal

Life-cycle cost analysis quantifies the true cost of government-provided services, which can then be compared to private sector costs for similar services. Life-cycle cost analysis considers all waste disposal cost elements including the necessary predisposal costs such as waste preparation, packaging and transportation. These costs are often budgeted for separately, and, as such, may be opaque. When analyzing life-cycle waste disposal costs, it is important to consider predisposal costs incurred at generator sites before waste disposal. These costs differ by disposal facility and, therefore, may influence the choice of disposal facility. Furthermore, the life-cycle cost metric is of major relevance when deciding whether to build a new disposal facility or expand an existing facility.

Reference materials for preparing and using life-cycle cost analysis include DOE Order 430.1B, *Real Property Asset Management*⁸ and the supplemental cost estimating guide, DOE G 430.1-1, *Cost Estimating Guide*⁹. This Guide provides a chapter dedicated to life-cycle cost analysis, which includes methods, common errors made in life-cycle cost analysis, and examples. In addition, OMB Circular A-94, *Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs*¹⁰ and the NIST-DOE/NISTIR 6968, *Guide to Reporting the Life-Cycle Cost of Environmental Management Projects*¹¹ also provide valuable information and are primary documents.

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Obtaining accurate comparisons between DOE disposal costs and commercial costs is not straightforward. The difficulty in comparing DOE costs with commercial pricing is tied to the differences in federal and commercial accounting practices and funding protocols, as well as the aggregate way in which DOE captures and reports costs in accounting systems. Some DOE disposal facilities are funded through a combination of direct funding through annual appropriations and disposal fees charged to waste generators. Fixed costs such as construction of a disposal facility, as well as costs for disposal facility closure and long-term stewardship, are typically direct-funded through annual appropriations. Disposal fees charged by DOE disposal facilities typically relate to the variable, e.g. operating cost. Furthermore, DOE facilities do not budget now for future costs tied to site closure and long-term stewardship because such funds will be requested from Congress when needed. In addition, DOE facilities dispose of some waste that could be eligible for commercial disposal and other waste that falls outside the waste acceptance criteria for commercial facilities. However, DOE facilities typically do not collect the costs associated with those wastes separately. By aggregating the costs, it is difficult to determine the costs associated with those wastes that could be disposed of in commercial facilities. Finally, different types of costs related to waste disposal may be budgeted for separately (e.g., regulatory, security, utilities, etc.).

In order to establish a solid basis for comparing life-cycle cost analyses across the complex, sites must use a consistent method to ensure comparable cost elements are included. Therefore, if life-cycle cost metrics are to be used to guide disposal site decisions, standardized protocols should be established to improve the bases for such decisions and for any subsequent audits or analyses.

Costs associated with waste generation, including remediation and D&D costs, are generally considered outside the scope of a life-cycle analysis and would not discriminate among disposal facility alternatives. Therefore, this particular cost element will not be considered in the NDS.

In July 2002 DOE submitted a report to Congress entitled, “The Cost of Waste Disposal: Life-Cycle Cost Analysis of Disposal of Department of Energy Low-Level Radioactive Waste at Federal and Commercial Facilities”¹². This report represents the most comprehensive study to date on the life-cycle costs associated with LLW disposition.

Figure 2 summarizes the results of the analysis, expressed in cost per cubic meter of waste for each disposal facility. Although the information is no longer current, the data represents a qualitative comparison between various disposal options. Note that the 2002 Report data below applies to LLW, not MLLW. The red bar in Figure 2 represents the disposal facility cost. For the EnergySolutions, Clive, Utah facility, this represents the EnergySolutions price for disposal. The unit cost of DOE disposal facilities was calculated as the present value of future costs divided by the total waste volume to be disposed of in the facility. The calculations for DOE facilities include all future construction, operation, closure, and long-term stewardship costs for the disposal facilities from FY2002 forward and reflect all planned future waste disposal from FY2002 forward. The blue bars represent the average cost for preparing, packaging, and transporting waste to the disposal facility (i.e., predisposal costs borne by DOE waste

generator sites). The total cost of waste disposal for a given waste stream is the sum of the predisposal costs (waste preparation, packaging, and transportation) and the disposal facility costs (which include construction, operation, closure, and long-term stewardship) and is reflected by the yellow bar in Figure 2. These costs are for contact-handled LLW. Costs for off-site disposal of remote-handled LLW may be much higher because of the special packaging, handling, and transportation required to safely handle the higher-dose waste. Likewise, MLLW disposal costs can generally be expected to be significantly higher because of extra characterization and treatment requirements.

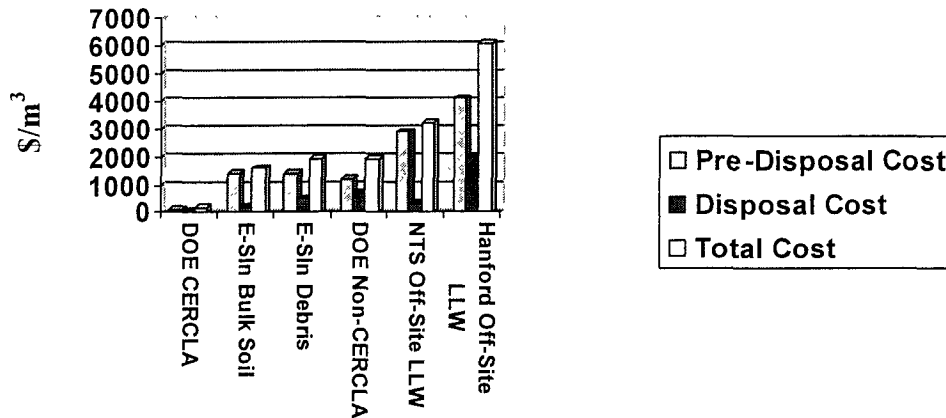


Figure 2 Costs of LLW Disposal Including Pre-Disposal Costs

The higher costs for disposal at the Hanford and NTS non-CERCLA off-site disposal facilities are due to smaller waste quantities and/or higher activity waste. The higher cost results from a combination of factors: maintaining a full service capability for all LLW waste types and activity levels, catering to small DOE waste generators with unusual/difficult to handle wastes (e.g., research wastes with unusual characteristics), and receiving lower volumes of waste.

Disposal facility costs are extremely sensitive to disposal volumes. Larger disposal volumes result in lower per-unit-volume cost. Changes in the quantity at any site can dramatically change the cost. For example, the life-cycle cost of the Hanford CERCLA facility, ERDF, is substantially lower than for other DOE or commercial facilities because of economies of scale from the large waste volumes. DOE projects that 1.8 million m³ of waste will be disposed of in ERDF from FY 2006 through FY 2035. For comparison, DOE predicts 240,000 m³ of waste in the DOE Idaho CERCLA cell and 1 million m³ in the DOE Oak Ridge CERCLA cell in the same time frame.

The following case study illustrates how disposal fees can be affected by waste volumes. It also demonstrates how modifying a waste disposal decision can affect the disposal costs of other waste streams.

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Case Study: Recent DOE/EM Paducah-Envirocare Analysis of Complex-Wide Cost Impacts in Integrating Large-Scale Waste Disposition Regimes

Disposing of a large quantity waste stream to a commercial TSDF may impact the costs of a given DOE disposal site. In 2005, the Portsmouth and Paducah Project Office (PPPO) performed a cost analysis for the disposal of the Paducah Gaseous Diffusion Plant's (PGDP) remaining 20,000 tons (37,000 m³) of contaminated scrap metal from the Paducah Northwest Scrap Yards. The disposition was originally part of the baseline plan for FY 2006 through 2007 with disposal being earmarked for NTS. The options under consideration were disposition at EnergySolutions, then known as Envirocare of Utah, or at NTS. PPPO evaluated five separate estimates regarding the disposal of the scrap metal at NTS and at the EnergySolutions Clive Facility. Given the large volume of waste material, PPPO also examined how the Paducah scrap metal waste volumes would impact upon the disposal unit rates that NTS charged to other DOE generators. A life-cycle cost analysis was performed to place the estimates on a common basis and to fully account for the NTS disposal site impacts.

Based on this analysis, PPPO determined that both a cost and schedule savings could be realized with the EnergySolutions disposition option. Cost savings associated with the PGDP project disposing at Clive, Utah was estimated to be about \$15M with several months of schedule acceleration also envisioned.

The PPPO analysis also revealed that the increase in cost to DOE waste generators disposing of waste at NTS as a result of the large-volume diversion to a commercial disposal site would be about \$1.6M over two years. This higher cost was a result of an increased tipping fee, i.e., the fee charged by NTS to users of the waste disposal site. About 40% of the cost would be borne by Paducah and/or PPPO. NTS tipping fee charges are calculated as a composite of fixed and variable costs based on a working crew size as a function of volume. If the waste volume decreases, the unit cost must increase to cover the NTS cost. For FY 2006, the NTS LLW tipping fee is \$ 461.15 per m³.

In this case study, the benefits from diverting the contaminated scrap metal to the EnergySolutions Clive, Utah site exceeded the increased costs to other NTS users. However, that may not always be the case. Large amounts of waste redirected to the commercial sector could adversely impact costs at DOE waste disposition sites. This factor should definitely be considered in the examination of future life-cycle costs for DOE waste disposition. This type of analysis has been done in the past for some sites that used Hanford for disposal.

As discussed above, the costs that precede disposal (i.e., waste preparation, packaging, and transportation) can be significantly greater than the costs at the disposal facility. High predisposal costs are normally associated with the more complex, higher radioactivity wastes, as well as mixed waste streams, such as those disposed of at NTS and Hanford, as well as certain LLW that requires stabilization before disposal. As

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illustrated, costs for DOE non-CERCLA on-site and off-site disposal facilities exceed those for on-site CERCLA disposal and some types of waste disposed at the EnergySolutions Clive Facility. However much of the waste disposed of in the non-CERCLA on-site disposal facilities at NTS and Hanford would not meet the current waste acceptance criteria of the CERCLA disposal facilities and commercial options and thus is not currently eligible for disposal in those facilities.

DOE experience indicates that insufficient planning may also result in higher pre-disposal unit costs. For example, in one case, a site contractor had inadvertently combined many small quantities of different RCRA wastes with different hazardous constituents, had allowed remediation soil stockpiles to become cross-contaminated over an extended period of time, and had combined low level and mixed-low level demolition wastes, all of which required expensive re-characterization and subsequent treatment. This lack of effective waste management is in conflict with DOE Order 435.1³, which requires a life-cycle plan and disposition pathway for each waste stream.

Therefore, based on the above, predisposal costs may represent significant life-cycle cost savings opportunities. Unit predisposal costs are strongly influenced by the radioactive constituents, the physical form, the origin of the waste, its point of generation relative to its disposal destination, and volume. These factors can result in substantial predisposal cost ranges. Predisposal cost savings could be best realized by (a) developing a common predisposal cost chart of accounts for use by all waste generators, (b) reevaluating site generator predisposal costs on a common basis, and (c) establishing contractor incentives to reduce predisposal costs, including incentives for commercial disposal facility operators, where applicable.

On-site disposal at DOE facilities frequently provides the lowest cost option. For example, DOE's on-site CERCLA disposal cells typically represent the lowest cost option for wastes eligible for disposal in those cells.

Waste Disposition Cost Data

DOE sites have the relevant historical and current cost information for the different cost elements of waste treatment and disposal. However, as noted above, it is frequently difficult to separate the costs specific to the predisposal of a given waste stream from the aggregate account. Comparing site cost elements from different sites is inherently difficult given the lack of specific accepted complex-wide protocols in gathering and tracking cost information. As noted in the 2002 DOE Report to Congress¹², cost elements had to be significantly adjusted in order to compare waste disposition costs. Recent progress has not addressed this particular shortcoming.

A number of DOE sites have either current arrangements or contracts with both commercial and Federal TSDF's. A site may have a specific waste disposition contract with a commercial vendor or may piggyback upon an existing contract with another DOE Office or site. Even though commercial TSDF's have set disposition rates, overall

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disposition costs can be highly variable depending upon such factors as service needs, soil/debris mix rates, and waste activity levels.

As noted below, there are a number of resources available that can either provide historical LLW/MLLW disposition cost data or provide the ability to estimate such data.

- **DOE LLW/MLLW Database** - The Department has recently developed a centralized LLW/MLLW database as a component of the Integrated Planning, Accountability, and Budgeting System (IPABS) database. This database collects planning data on waste volumes for the disposition pathways of the Department's LLW and MLLW streams but does not currently collect cost information, although this component may be added later. This database is discussed below in a later section of the NDS.
- **Environmental Cost Analysis System (ECAS)** - The Environmental Cost Analysis System (ECAS) is an existing computerized Oracle database that contains pertinent historical DOE EM cleanup project cost information, including LLW and MLLW activities. For a further discussion, refer to Appendix C.
- **Site(s) Baseline Costs** - Baselines in DOE provide detailed documentation regarding a project's scope, cost and schedule and are developed to support a Congressional budget request. DOE baselines are activity based, i.e., developed from the bottom-up, and generally entail out-year projections until project completion. DOE sites are required to have baselines developed for EM project work scope based on the requirements of DOE Orders and Guidance, which include DOE Order 413.3, Project Management for the Acquisition of Capital Assets¹³. Baselines are required to be developed between the CD-1 (Project Definition) and CD-2 (Project Execution) Project Management Phases. See DOE Order 413.3 for more details.
- **Remedial Action Cost Engineering and Requirements (RACER) Model and Other Tools** - The Remedial Action Cost Engineering and Requirements (RACER) model is an automated parametric cost estimating tool that can be used to estimate costs for all phases of environmental cleanup work. The phases include assessment/study, remedial design, interim action, remedial action/restoration, operations and maintenance, site close-out, and site work. Although not specifically emphasized, RACER also has the capability to parametrically estimate waste management related cleanup costs. For a further discussion of some of these resources, refer to Appendix C.

Other cost estimating tools are being used at DOE sites, principally by the contractor work force. These more detailed estimating packages include Winset at the Idaho and Hanford sites, Timberline at the Lawrence Berkeley/Lawrence Livermore and Nevada Test Sites, and Success at the Savannah River Site. Primavera software is also extensively used by our EM contractor workforce, but Primavera is a scheduling/project management tool rather than a cost estimating package.

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Despite these cost estimating tools, all of the current packages, including RACER, lack the ability to do systematic predictive modeling. This type of cost modeling is of paramount importance in conducting life-cycle cost analyses and planning future LLW/MLLW disposal. Even though an accurate cost model depends on a definitive estimate of waste types and volumes, parametric cost modeling using approximate waste data should adequately serve DOE to predict the complex-wide life-cycle cost analysis of LLW/MLLW streams.

DOE Low-Level Waste/Mixed Low-Level Waste and Materials Database

To develop the tools to integrate the complex-wide management of LLW/MLLW treatment and disposal, it is necessary to possess accurate estimates of the quantity and type of present and future LLW/MLLW streams. When the NDS was still in the development stage, such data did not exist at the complex-wide level. Previously, EM had developed a centralized database, the IPABS Stream Disposition Data (SDD). This database documented DOE's management strategy for more than 4,000 waste, contaminated media, spent fuel, and nuclear materials streams. The SDD was also used as input to the Central Internet Database, a DOE database designed for public use. Because of the complex effort required to maintain the IPABS SDD and the fact that long-term cleanup plans were undergoing significant revision, EM discontinued this database in 2001.

Concurrent with the development of this strategy, EM, under the auspices of the Office of Commercial Disposition Options (EM-12), developed a centralized LLW/MLLW database as part of IPABS. Although the data is collected, validated and managed by EM, the data may be accessed via the Waste Information Management System (WIMS) internet tool developed by Florida International University. WIMS may be found at: <http://ptkpwweb.hcet.fiu.edu.wims>. The data collected in IPABS and displayed in WIMS is rolled up to a comparatively high level with approximately 10% of the number of waste streams as compared to the 2001 SDD data. WIMS also displays data in graphical formats, e.g., disposition maps and geographical maps.

The WIMS and the underlying IPABS data help assist communication between DOE Headquarters and the field sites on TBD waste streams. In turn, this communication may lead to increased use of commercial or Departmental resources and identify complex-wide solutions to these waste streams.

The LLW/MLLW database assists the Department in developing a complex-wide approach to LLW/MLLW treatment and disposal and consequently improves efficiencies. Because each site disposes of its LLW and MLLW individually, opportunities may be lost for economies of scale. Multiple sites with similar waste streams may be able to negotiate more favorable disposal rates. Furthermore, with each site independently disposing of waste, some sites may be maintaining duplicative capabilities. In addition to capacity issues, lack of integrated planning may result in various sites competing for limited treatment or disposal capability, e.g. TSCAI.

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In the future, cost information could be a component of this LLW/MLLW database. However, at this time there are no uniform requirements for defining, monitoring and reporting waste treatment and disposal costs. Across the DOE Complex, there are significant site-to-site protocol differences in collecting cost information. If the Department is to use life-cycle cost metrics to guide disposal site decisions, standardized protocols should be established to improve the bases for such decisions and for any related analyses.

Radiological Release of Waste for Disposal in a Landfill

Once waste is produced, various options such as the sorting and segregation of radiological contaminants and the subsequent release of wastes from radiological controls can reduce the amount of waste that has to be disposed of as LLW. Under the Department's radiation protection requirements, waste and materials (such as building structural components and equipment) may be released from radiological controls for restricted or unrestricted use. For waste disposal, this can result in more appropriate and economical disposal as well as minimizing the LLW requiring disposal. Restricted radiological release of waste materials, for example, allows hazardous waste containing trace quantities of residual radioactive material to be disposed in a RCRA Subtitle C hazardous waste landfill or non-hazardous waste with an acceptably low radiological component to be disposed at a Subtitle D landfill.

DOE radiological release requirements are contained in DOE Order 5400.5, *Radiation Protection of the Public and the Environment*¹⁴, and the companion DOE Guide 441.1-xx *Implementation Guide, Control and Release of Property with Residual Radioactive Material*¹⁵. The DOE Order governs radiation protection related to released property through the use of "authorized limits" which are the radiological release criteria. The Order provides authorized limits for radioactivity on surfaces, using the release criteria in Figure IV-1 of DOE Order 5400.5. The release criteria in this Order only apply to materials with surface contamination. Authorized limits for materials containing residual radioactive material in mass or volume must be derived consistent with the requirements and processes in DOE G 441.1-xx, and approved by the Assistant Secretary for Environment, Safety and Health (EH-1). Similarly, authorized limits for radioactivity on surfaces different than those in DOE Order 5400.5 may be approved by the DOE on a case-by-case basis. This approval authority has been delegated to Field Office Managers under certain circumstances. Consequently these managers may approve authorized limits under conditions discussed in DOE G 441.1-xx. Potential doses must be maintained as far below dose constraints as is reasonably achievable through an ALARA process, i.e. As Low as Reasonably Achievable (ALARA). It must be demonstrated that the potential dose will be below the individual dose constraint of 1 mrem/year to any individual and 10 person-rem/year, collective dose. DOE G 441.1-xx also clarifies the authority to approve alternate ALARA/dose-based derived authorized limits for surfaces or activity in mass or volume where potential doses are less than the 25 mrem dose constraint but in excess of 1 mrem/year individual dose or 10 person-rem/year collective dose.

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Great care should be taken that authorized limits intended for release of materials into landfills are not misused in any way. For example, incinerators greatly reduce the volume of flammable wastes. Consequently, trace amounts of residual radioactivity could become concentrated in the ash, or perhaps released into the atmosphere, if the waste were incinerated rather than disposed in a landfill.

In January 2001, the Secretary directed the establishment of a Department Clearinghouse for the internal reuse of contaminated lead. Since implementation in 2001, the Lead Recycle Program has diverted approximately 600 tons of contaminated lead from the mixed waste stream into radiation shielding for operational and waste disposal uses in DOE and NRC-regulated activities. This program was supported by environmental interest groups and industries and successfully demonstrated well-controlled radiological uses of the lead.

Wastes with trace radioactivity can be disposed of in local landfills if they meet authorized limits. Minimizing waste that must be managed as LLW reduces waste disposal costs through lower disposal and transportation costs, and potentially may lower transportation risks, without compromising human health and the environment. The Oak Ridge Site has been relying on the authorized limits process to dispose of very low activity waste in an on-site landfill (Industrial Landfill V) since 2003. Approval was granted by the Oak Ridge Field Office Manager with EH concurrence after coordination with the State of Tennessee. Oak Ridge estimates that use of Landfill V for very low activity waste disposal results in cost savings of approximately \$350/m³, compared with disposal at commercial or DOE radiological waste landfills. The Oak Ridge Site has just commenced the process of obtaining approval to dispose of very low activity D&D waste in another on-site disposal facility, Construction/Demolition Landfill VII. This construction and demolition landfill will accept only debris.

The Paducah Gaseous Diffusion Plant has been using authorized limits to release very low activity waste from radiological control since 2003. The waste is then disposed of at a landfill located on-site (Landfill C-746-U). The requested authorization limits demonstrate that the public dose is less than 1 mrem/year with the calculated worker dose at approximately 2 mrem/year. EH approved the

authorized limits in February 2003. The Paducah Site estimates that this process will produce cost savings of approximately \$1 to \$3 million per year and reduce transportation risks, while protecting human health and the environment.

The SRS has instituted an authorized limits process to allow waste with an insignificant low-level radiological component to be disposed of in an on-site landfill. The site developed dose-based criteria. The proposed alternate criteria kept doses well below the DOE Order 5400.5 public dose constraint (100 mrem/year); the dose constraints referenced in subsequent guidance (1 mrem/year, maximum individual dose or 10 person-rem/year, collective dose) or the ANSI/HPS N13.12 standard dose criteria (1 mrem/year). These constraints protect the health and safety of the workers, the public and the environment. The SRS received EH approval to use the authorize limits in August 2003. The site and the State of South Carolina have reached agreement on the limits.

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As an example of the cost savings that can be produced from the proper use of authorized limits for radiological release, SRS estimates the direct operational cost to dispose of LLW at the SRS LLW Slit Trench to be \$95/m³ for bulk waste (typically D&D waste) and \$ 68/m³ for soils and debris. The cost to dispose of waste at the on-site Three Rivers sanitary landfill is about \$30/m³. Therefore, for most D&D waste the direct cost savings, relative to disposal as LLW, will be approximately \$65/m³, or 70%, while for soils and debris, the direct cost savings would be about \$38/m³, or 55%. The benefits of authorized limits for local disposal also include the protection of human health and the environment and possible reduced transportation risks if the waste shipping distances are shorter.

Benefits in using authorized limits are not confined to cost savings only. The use of the authorized limits process preserves valuable disposal capacity at radioactive waste disposal sites as well as minimizing the amount of LLW requiring disposal.

Low-Level Waste & Mixed Low-Level Waste Disposition Gap Analysis

Given LLW and MLLW disposition data from the Phase I sites, the NDS project team conducted a gap analysis to identify disposal capacities and potential constraints to treatment or disposal. The WIMS was used to generate disposition maps of each major waste stream from the major EM sites. The disposition maps were then analyzed to identify any potential disposition bottlenecks.

The gap analysis confirms that adequate capacity exists using both commercial and federal disposal facilities for the Department's LLW, potentially out to FY 2035. In addition, it is to the Department's benefit that many of the LLW/MLLW streams from multiple sites are similar, which will assist in establishing a complex-wide disposition strategy. Furthermore, all potential treatment or disposal sites, both DOE and commercial, possess the necessary permits and licenses or, as is the case with a few vendors (such as WCS), are in the process of obtaining them.

One potential gap may be the continued availability of the TSCAI. Per the IPABS data, the Paducah Gaseous Diffusion Plant (PGDP) plans on shipping 590 m³ of MLLW to TSCAI for incineration in FY 2011-2015. Current plans have scheduled TSCAI operations until 2009. Beyond that date, its future is uncertain, and will be determined based on the inventory of wastes still needing thermal treatment and the availability of cost effective alternative treatment methods. However, both the Perma-Fix (M&EC) and EnergySolutions VTD units can treat many of the same waste streams as the TSCAI, with the exception of wastes with PCB contaminations in excess of 50 ppm. These VTD units produce an aqueous waste stream that then requires treatment prior to disposal. Currently, these aqueous effluent streams are thermally treated by TSCAI. However, the commercial TSDF sector is developing the thermal treatment capability to replace the TSCAI. Should this treatment capability be brought on-line, there may be no gap in treatment capability.

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A second potential gap may be the available disposal capacity for INL LLW. The Low-Level Waste Disposal facility at the RWMC is scheduled to stop receiving contact handled LLW in 2008 and to stop remote handled LLW receipts and close in 2009. The Department is currently evaluating the disposal options for both on-site and off-site disposal of INL site LLW facility after the SDA closes. Although it appears that adequate off-site disposal capacity exists, further analysis is needed to adequately assess the cost effectiveness of this option.

In addition, NTS currently provides the only disposal pathway for MLLW between 10 - 100 nCi/gm. However, the NTS MLLW disposal facility will close in November 2010 or prior to this date if the 20,000 m³ capacity in the RCRA permit is reached. After this date, the Department may have to consider commercial disposal options or develop additional capacity at a DOE site. At present there is no commercial waste site that can accept MLLW above Class A limits, in particular MLLW with transuranic radionuclide concentrations between 10 - 100 nCi/gm. However, WCS has applied for a disposal license for LLW and DOE MLLW, including Class B and C MLLW. The outcome of this licensing process and WCS's business decision whether to construct this commercial disposal facility are uncertain. A State of Texas license approval or disapproval is anticipated in late 2007 or early 2008.

As an example of the issues posed by these waste streams, until recently some transuranic MLLW containers in the range of 10-100 nCi/gm (i.e., > NRC Class A) had been packed together with containers of higher level waste and sent to WIPP. This process, called load management or concentration averaging, involves packing separate waste containers together in a larger container. Placing containers of > Class A MLLW with higher level waste containers can result in the larger container meeting the WIPP WAC. However, the Department is concerned about ultimately exceeding the total WIPP capacity, and is consequently recommending minimizing load management. Consequently, some 10-100 nCi/gm MLLW may now require a new disposal pathway. One possible disposal site may be the NTS MLLW disposal facility; however, as noted above, this facility will cease operations by November 2010. Consequently, other waste treatment and disposal options for this waste are being examined.

It is apparent from the gap analysis that the Department benefits from the existence of multiple disposal sites, both federal and commercial, which provide disposal alternatives. A number of TBD MLLW streams are identified in Appendices D through H.

Contractual Issues and Evolving Contracting Strategies

DOE-EM has developed an overall acquisition strategy to tailor its contracting approach to the planned cleanup challenges at each site. At the closure sites, EM has carefully defined the remaining work scope and estimated the target cost and schedule to complete. Cost-Plus Incentive Fee (CPIF)-based closure contracts provide the site contractors sufficient flexibility to define the best approach to safely complete the projects. Incentive-based contracts provide specific incentives for specified performance outcomes, often driven by site-specific goals and objectives in areas such as health,

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safety, schedule, cost, or other areas, as negotiated between DOE and the contractor. The contracts also provide considerable fee incentive for the project to be completed early and under cost, and commensurate fee penalties for over-cost or late project performance.

For shorter-term cleanups and/or for certain task-based requirements, EM has begun to employ Indefinite Delivery/Indefinite Quantity (ID/IQ) type contracts for its work scope. These contracts have the advantage of being able to be awarded in a relatively short period of time. The solicitation and award of the Ashtabula (Ohio) Closure Project Task Proposal is an example of this contract mechanism.

Several site contracts contain specific incentives for the disposition of waste. As the Department develops the methods to integrate the complex-wide management of LLW/MLLW disposition, all existing site contracts and waste-related subcontracts will be reviewed to identify requirements related to waste disposal and life-cycle cost analysis. Following this review, the Department may recommend specific contract actions to improve LLW/MLLW management activities. Some of these contract actions may include establishing new centralized ID/IQ type contracts with treatment and disposal sites.

EM Headquarters has recently established an Office of Procurement Planning to develop EM acquisition strategies. This office will evaluate current site contracts and plan future procurements. As the Office of Procurement Planning develops new acquisition initiatives, specific opportunities to apply these ideas to improve LLW/MLLW treatment and disposal will be examined.

Conclusions

Overall, adequate near-term disposal capacity exists.

There is currently adequate near-term capacity using both DOE and commercial TSDF's for the bulk of the Department's LLW and MLLW. However, the NTS MLLW disposal facility will close by November 2010. The lack of the NTS MLLW disposal facility may be further exacerbated by additional 10 – 100 nCi/gm MLLW that had previously been planned to go to WIPP for disposal. After November 2010, the Department may have to consider other federal and commercial disposal options. In addition, individual TBD MLLW streams exist.

There may be future concerns regarding the disposal for higher-activity MLLW.

The long term availability of disposal for higher-activity MLLW poses a significant risk and will have to be monitored closely. For example, limited disposal capacity exists for MLLW with transuranic (TRU) radionuclide concentrations between 10 and 100 nCi/gm. Only NTS and Hanford have regional disposal facilities that can accept this waste from other DOE sites and off-site waste cannot currently be disposed of at Hanford. The NTS

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MLLW disposal facility will close by November 2010. Consequently, the disposal path for this higher activity MLLW beyond that date remains uncertain.

The Department benefits from the existence of multiple disposal sites, both federal and commercial, which provide disposal alternatives.

The management of the Department's LLW/MLLW disposition is a complex undertaking that requires flexibility. The waste management system must be agile and able to respond to sudden changes and dynamic circumstances. Therefore, it is advisable to foster federal and commercial treatment/disposal alternatives when economically feasible.

Cost is not the only factor to consider when selecting a LLW/MLLW disposal path.

Life-cycle costs, although significant, are only one factor to consider when making a waste treatment/disposal decision. Technical risk, worker protection, and schedule adherence are other essential factors. Although understanding the life-cycle costs associated with waste treatment and disposal is important, cost should not be the sole consideration.

The LLW/MLLW predisposal costs may represent significant life-cycle cost savings opportunities.

Predisposal cost savings may be best realized by developing a common predisposal cost chart of accounts for use by all waste generators and reevaluating site generator predisposal costs on a common basis.

Recommendations

Identify cost data requirements

An information management system containing cost data will allow DOE personnel to understand and track waste treatment and disposal costs. Therefore, the specific waste treatment and/or disposal cost data to be monitored at a complex-wide level should be identified and a common cost methodology/basis defined. Estimates of future waste volumes, particularly within Deactivation and Decommissioning (D&D) projects, are often inaccurate. Accurate waste volume, and correspondingly accurate cost projections, will assist waste management disposition planning and subsequent decision-making. Consequently, the Department may consider the development of a predictive cost model.

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Develop and implement guidance for LLW/MLLW life-cycle disposition cost analyses

LLW/MLLW life-cycle disposition costs are those pre-disposal costs incurred in the preparation and transportation of a given waste stream as well as the costs associated with the construction, operation, and closure of a LLW/MLLW treatment/disposal facility. Furthermore, incomplete or inconsistent life-cycle planning for waste disposition may result in increased pre-disposal costs due to additional handling, characterization, storage, and processing. The various DOE sites do not uniformly or systematically track these costs. Without complete, well-documented life-cycle analyses, cost saving opportunities may be overlooked.

Therefore, in order to accurately quantify LLW/MLLW life-cycle disposition costs, it is recommended that the existing guidance should be reviewed and a schedule developed to revise the life-cycle cost guidance for LLW/MLLW disposition decisions. This revised guidance should encourage sites to conduct life-cycle planning prior to waste generation. This document should include specific requirements on what elements in waste disposition defines a “cradle-to-grave” approach and the methodology required to implement a robust life-cycle cost analysis for waste disposition. The Guidance should refer to established DOE Technical Guidance where possible and should also detail the specific instances where a life-cycle analysis should be applied and the rigor in which it should be performed. Consideration will be given to the GAO’s specific recommendation to include specific requirements in contracts.

Maintain and formalize coordination with the commercial LLW/MLLW treatment and disposal industry.

The effective treatment and disposal of the Department’s LLW/MLLW requires a combination of both federal and commercial capabilities. In order to identify the most cost effective treatment/disposal alternatives, channels with the commercial TSDF industry have to be maintained and enhanced to improve partnering and to identify the most cost effective treatment/disposal alternatives. Specifically it is recommended:

- Continue the Joint Department of Defense (DOD)/DOE Low-Level Radiological Waste and Mixed Waste Generators Conference. In May 2005 EM-12, the Office of Commercial Disposition Options, co-sponsored a Joint DOD/DOE Low-Level Radiological Waste and Mixed Waste Generators Conference (FEDRAD). During this conference, DOE personnel were able to discuss with commercial vendors and resolve some problematic MLLW issues in an informal setting. The second FEDRAD conference was held in June 2006. It is recommended that these conferences continue to be held annually as a means to facilitate communication between the Department and the commercial LLW/MLLW treatment and disposal industry.
- Participate in industry forums, such as the Fuel Cycle Facilities Forum sponsored by the Nuclear Energy Institute, and professional societies such as the American Nuclear Society and the American Institute of Chemical Engineers.

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Resolve any contractual impediments to implementing life-cycle cost analysis.

Review all existing site contracts and waste-related subcontracts to identify requirements related to waste disposal and life-cycle cost analysis. Following this review, specific contract actions to improve LLW/MLLW management activities may be recommended.

Use authorized limits when advisable to release waste from radiological controls prior to disposal.

The use of authorized limits can result in significant cost savings and waste minimization while still protecting the health and safety of workers, the public and the environment. To ensure that this approach is properly utilized, it is recommended that:

- A complex-wide conference be held for presentations and lessons learned on the establishment and use of authorized limits for the radiological release of waste.
- Methods be developed to communicate the authorized release approach across the complex, e.g. web page, lessons learned, etc.
- DOE Guide 441.1-xx be revised, as necessary, finalized and issued.

Implementation

The National LLW/MLLW Disposition Strategy is the framework under which the Department will integrate management of LLW/MLLW treatment and disposal. This document applies primarily to major EM sites. Subsequently, the NDS scope will be expanded to examine additional DOE sites. Once the National LLW/MLLW Disposition Strategy is published, the following steps will be taken by EM to fully implement the strategy:

- Complete review of existing site exemptions. Under DOE Manual 435.1-1⁴, Field Office Managers may approve exemptions for use of non-Department treatment or disposal facilities. Exemptions demonstrate that it is cost effective to use non-Department facilities. Before the exemptions for disposal take effect, DOE-HQ is notified and the Office of Environment, Safety and Health is consulted. This process has led to a number of exemptions. In many instances the exemptions call out specific waste streams and quantities. Others are “blanket” exemptions that cover a general category of waste. This review will result in information on the extent and type of cost analysis currently being conducted. The results of the review will inform the Department on next steps, e.g., life-cycle cost analysis will be required as part of all future Departmental exemption determination documents. Planned completion date: April 2006.

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- Complete a review of the existing guidance on life-cycle cost analysis. The Department will review the existing guidance and develop a schedule to prepare revised guidance, if necessary, for life-cycle cost analysis involving LLW/MLLW disposition decisions. Planned completion date: June 2006.
- Several site contracts contain specific incentives for the disposition of waste. Contracts also mandate requirements. As the Department moves forward to integrate the management of LLW/MLLW disposition, all existing site contracts, waste-related subcontracts, and complex-wide waste contracts will be reviewed to identify requirements and incentives related to waste disposal and life-cycle cost analysis. Following this review, the Department may recommend specific contract actions to improve LLW/MLLW management activities. Planned completion date: April 2006
- Construct a Project Management Plan to describe how DOE will manage LLW/MLLW disposition on a complex-wide basis. This Project Management Plan will include the topics listed in DOE Manual 435.1-1, *Radioactive Waste Management Manual* ⁴, for the complex-wide LLW and MLLW radioactive waste management program plan. Planned completion date: March 2007
- Conduct programmatic risk assessment of TBD MLLW streams and develop disposition contingency plans. Planned completion date: December 2006
- Determine the benefits of developing a predictive cost model and, if worthwhile, specify the model requirements. Accurate waste volume, and correspondingly accurate cost projections, will assist waste management disposition planning and subsequent decision-making. Planned completion date: September 2007

References

1. *“Improved Guidance, Oversight, and Planning are Needed to Better Identify Cost-Saving Alternatives for Managing Low-Level Radioactive Waste”*, Report Number GAO-06-94, U.S. Government Accountability Office, dated October 2005.
2. *The Department of Energy Strategic Plan*, dated 30 Sept. 2003.
3. DOE Order 435.1, Change 1, *Radioactive Waste Management*, dated 28 Aug. 2001.
4. DOE Manual 435.1-1, Change 1, *Radioactive Waste Management Manual*, dated 19 June 2001.
5. *The Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage and Disposal of Radioactive and Hazardous Waste (EIS-0200)*, U.S. Dept. of Energy, Office of Environmental Management, May 1997.
6. DOE Guide 435.1-1, *Implementation Guide for use with DOE M 435.1-1*, dated 9 July 1999.
7. *Record of Decision for the Solid Waste Program, Hanford Site Richland WA: Storage and Treatment of Low Level Waste and Mixed Low Level Waste and Storage, Processing and Certification of Transuranic Waste for Shipment to the Waste Isolation Pilot Plant*, Federal Register, Vol. 69 No. 125, dated 30 June 2004.
8. DOE Order 430.1B, *Real Property Asset Management*, dated 24 Sept. 2003.
9. DOE Guide 430.1-1, *Cost Estimating Guide*, dated 28 March 1997.
10. OMB Circular A-94, *Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs*, dated 29 Oct. 1992.
11. Schultz, L.I. and Weber, S.F., *Guide to Computing and Reporting the Life-Cycle Cost of Environmental Management Projects*, NISTIR 6968, U.S. Dept. of Commerce, Technology Administration, National Institute of Standards and Technology (NIST), March 2003.
12. *Report to Congress, “The Cost of Waste Disposal: Life-Cycle Cost Analysis of Disposal of Department of Energy Low-Level Radioactive Waste at Federal and Commercial Facilities”*, U.S. Department of Energy, Office of Environmental Management, dated July 2002.

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13. DOE Order 413.3, Change 1, *Project Management for the Acquisition of Capital Assets*, dated 13 Oct. 2000.
14. DOE Order 5400.5, *Radiation Protection of the Public and the Environment*, dated 7 Jan. 1993.
15. DOE G 441.1-xx, *Implementation Guide, Control and Release of Property with Residual Radioactive Material*.
16. “DOE Should Reevaluate Waste Disposal Options Before Building New Facilities”, Report Number GAO-01-441, U.S. Government Accountability Office, dated May 2001.

APPENDIX A

GREATER- THAN-CLASS C LOW-LEVEL WASTE DISPOSITION

Greater-Than-Class C (GTCC) waste is LLW with concentrations of radionuclides that exceed the limits established for Class C radioactive waste, as defined by 10 CFR 61.55. The Low-Level Radioactive Waste Policy Amendments (LLRWPA) Act of 1985 assigned to the Federal Government responsibility for the disposal of GTCC radioactive waste generated by NRC or Agreement State licensees, which is not owned or generated by DOE, by the United States Navy from decommissioning vessels, or by certain other federal activities. The GTCC LLW disposal facility must be licensed by the NRC.

On May 11, 2005, DOE published an Advanced Notice of Intent to prepare an EIS, the first step in a process that will ultimately lead to a decision and implementation of a disposition option for GTCC LLW. The scope of the EIS will include disposal capacity that will be needed for current and projected GTCC LLW generated by NRC or Agreement State licensees. Based on DOE's inventory review, the scope of the EIS may also include DOE wastes with characteristics similar to GTCC waste for which there is no identified path to disposal. Alternatives to be considered include disposal in new or existing DOE or commercial facilities, including greater confinement disposal configurations, geologic disposal, or enhanced near-surface disposal facilities. The varied forms of GTCC LLW may make multiple locations and disposal methods desirable, and the EIS will evaluate such options. New facilities that could offer greater confinement disposal would include capabilities such as boreholes, intermediate depth disposal, and other specially designed facilities. DOE would also consider which types of GTCC LLW could be safely disposed of in existing commercial LLW disposal facilities and DOE disposal facilities. The potential environmental impacts of using both existing and new facilities owned and operated by DOE as well as existing and new facilities owned and operated by commercial licensees will be considered. DOE will evaluate whether all waste types can or should be disposed of in the same facility or whether different waste types would best be disposed of in different facilities. The LLRWPA Act also provides that the Federal Government is responsible only for the disposal of GTCC LLW. LLW generators licensed by the NRC must send their waste to commercially operated, NRC or state regulated and licensed disposal sites. DOE does not regulate commercial radioactive waste. Conversely, DOE LLW disposal sites are not regulated or licensed by the NRC. Therefore, it should be noted that commercial LLW, including GTCC, may not be disposed of in a DOE facility that has not been licensed by the NRC.

DOE plans to issue a Notice of Intent to prepare an EIS in mid-2006, which will be followed by a public scoping period. When available, DOE will announce the availability of the Draft EIS in the Federal Register and other media, and will provide the public, organizations, and agencies with an opportunity to submit comments. These comments will be considered and addressed in the Final EIS. DOE will issue a Record of Decision (ROD) no sooner than 30 days after publication of the EPA's notice of availability of the Final EIS. This process is expected to take about two years. As required by Section 631 of the Energy Policy Act of 2005, DOE will submit, by August

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8, 2006, a report to Congress containing an estimate of the cost and a proposed schedule to complete an EIS and Record of Decision. Section 631 also requires that, upon completion of the EIS, DOE report to Congress on the disposal alternatives and await Congressional direction before implementing a decision.

APPENDIX B

LIFE-CYCLE COST ANALYSES OF LOW-LEVEL WASTE AND MIXED LOW-LEVEL WASTE TREATMENT AND DISPOSAL COSTS

In 2001, the GAO evaluated the Department's method of deciding where to dispose its LLW streams, particularly how the Department decided to dispose of LLW on-site rather than off-site. In the subsequent report, "DOE Should Reevaluate Waste Disposal Options Before Building New Facilities" ¹⁶, the GAO recommended that cost analyses should be periodically updated to take into account changing economic conditions and to determine that the most cost-effective waste disposal alternative is still being pursued. On this basis, the Conference Committee for the 2002 Energy and Water Development Appropriations Act directed DOE to prepare a cost study analyzing the life-cycle costs of LLW management alternatives and to submit an objective analysis comparing life-cycle costs of on-site versus off-site disposal alternatives. Congress was concerned that DOE was not using thorough life-cycle cost analysis to determine the most cost-effective waste treatment and disposal options. Congress stated that DOE needed to (1) compare alternatives, such as use of on-site and off-site DOE disposal facilities compared to commercial disposal facilities; and (2) prepare complete life-cycle cost analysis of DOE's disposal site costs to allow comparisons with commercial disposal facility alternatives.

In July 2002, DOE submitted its Report to Congress entitled: "The Cost of Waste Disposal: Life-Cycle Cost Analysis of Disposal of Department of Energy Low-Level Radioactive Waste at Federal and Commercial Facilities" ¹². The report concluded that: 1) generator site pre-disposal costs offer the greatest opportunity for cost savings; 2) on-site DOE disposal cells for cleanup waste are cost effective; 3) commercial facilities offer the lowest disposal cost for some DOE waste; 4) DOE disposal sites offer services not available commercially; and 5) comparison of disposal alternatives must consider more than disposal fees. The report also alluded that there was fragmented guidance and little consistency in how each site collected pre-disposal and disposal cost data and how each site formulated its waste management decisions based on life-cycle cost analysis.

In July 2002, the Assistant Secretary for Environmental Management signed a Memorandum entitled "Low-Level Waste Disposal Cost Study: Implementing the Results". In the Memorandum, the Assistant Secretary, based on the findings of the 2002 DOE Report to Congress, directed the following actions to be taken:

- Before any existing CERCLA cell is expanded or a new facility built, a life-cycle cost analysis must be completed. The documentation of this analysis should be presented as part of the decision to proceed with expansion or new construction.
- To facilitate the use of licensed, commercial facilities, DOE Waste Management Order 435.1, *Radioactive Waste Management* ³, and the corresponding DOE Manual 435.1-1, Change 1, *Radioactive Waste Management Manual* ⁴, should be changed to remove the requirement for an exemption to use non-DOE disposal facilities. Instead, each Field Office Manager must ensure that disposal decisions are based on technical acceptability, schedule, and cost benefit.

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- Each Field Office should develop the mechanisms necessary to establish that their LLW disposal decisions include the best estimate of full “cradle to grave” costs and analysis of alternatives. These costs should include waste preparation, packaging, transportation, and disposal costs. Documentation of these analyses will be made available to support future reviews of disposal decisions and should also include other factors used to inform disposal decisions, such as schedule.

In October 2005, GAO published a report to the Subcommittee on Energy and Water Development, Committee on Appropriations, House of Representatives, entitled: “Improved Guidance, Oversight, and Planning are Needed to Better Identify Cost-Saving Alternatives for Managing Low-Level Radioactive Waste”¹. During 2003 and 2004, GAO auditors visited six DOE sites (representing more than 70 percent of LLW disposal by DOE during this timeframe) and found that cost analyses were informal and not always documented or sometimes lacked adequate supporting documentation.

The report concluded that cost analyses are not complete, current, or well documented and that DOE’s guidance and contractor oversight are weak. The report also documented challenges in achieving an integrated department-wide strategy in the areas of: 1) collecting basic data on the amounts of LLW needing disposal; 2) overseeing LLW management in a department with a complex organization and multiple missions; and 3) addressing the impacts of recent State actions.

The GAO report particularly noted that DOE sites have not consistently used life-cycle cost analysis in part because EM’s 2002 guidance on life-cycle cost analysis lacked the needed detail for how and when to use life-cycle cost analysis. EM’s 2002 guidance directed sites “to develop mechanisms necessary to establish that its LLW disposal decisions include the best estimate of full ‘cradle to grave’ costs and analysis of alternatives.” GAO contended that each site alone was then responsible for deciding how to incorporate cost into its LLW management decisions.

APPENDIX C

RESOURCES AVAILABLE FOR LOW-LEVEL WASTE/MIXED LOW-LEVEL WASTE COST DATA

Environmental Cost Analysis System (ECAS)

The Environmental Cost Analysis System (ECAS) is an existing computerized Oracle database that contains pertinent historical DOE EM cleanup project cost information, including LLW and MLLW activities. ECAS was originally developed and maintained by the National Energy Technology Laboratory under the auspices of the DOE EM Applied Cost Engineering (ACE) Team (consisting of EM and contractor members from Field and Program Offices). The operational responsibility has shifted to the Savannah River Site where the database is now presently being reconfigured and maintained. The EM Office of Business Operations now funds and manages the operation of the system, along with IPABS.

ECAS is a robust computer database system in which the initial cost data is manually entered by the project sites. The system uses a pre-formatted Environmental Cost Element Structure and has the capability to reference project cost information for LLW/MLLW TSDF activities. The system can be readily expanded to not only accommodate additional cost information but also has the potential to incorporate increased functionality as well. For example, the system could be functionally expanded to calculate unit costs for project TSDF activities.

Currently, there are 22 completed projects from six DOE Field Operations Offices with a total cost of \$457M. The near-term future plans for ECAS include incorporating all of the completed Rocky Flats Environmental Technology Site cleanup project work cost information into this database.

Although ECAS has the capability to expand to accommodate more detailed waste disposition cost information, it presently makes use of limited cost data that may not be consistently applied between the cleanup sites.

Remedial Action Cost Engineering and Requirements (RACER) Model

The Remedial Action Cost Engineering and Requirements (RACER) model is an automated parametric cost estimating tool that can be used to estimate costs for all phases of environmental cleanup work. The phases include assessment/study, remedial design, interim action, remedial action/restoration, operations and maintenance, site close-out, and site work. Although not specifically emphasized, RACER also has the capability to parametrically estimate waste management related cleanup costs.

The system was originally developed in 1991 under U.S. Air Force funding to estimate environmental budgets. The system has been upgraded numerous times with a newly

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revised version available as RACER 2006. More than 800 federal government entities use RACER, including the DOE EM Program.

The primary benefits identified by the U.S. Air Force for using RACER include:

- Consistent approach
- Accepted by audit agencies
- Provides sound estimates without requiring advanced engineering/cost knowledge
- Easy to use
- Significant user base across Federal Government
- Accepted by regulatory and other public agencies
- Software provides significant flexibility for tailoring by individual user; design allows easy updating and enhancements

In estimating waste management related cleanup costs, RACER uses developed cost rates based on Federal project information (including DOE EM project costs) that are periodically updated by the U.S. Air Force. RACER's ability to estimate waste management costs can be applied throughout the different work activities of the project, such as remedial action and operations and maintenance. Thus, it has the capability of directly estimating waste disposition costs.

The DOE EM ACE Team has spearheaded the effort to accept RACER as a key EM cost estimating tool. The effort included the exchange of cost information and cost savings ideas, the formulation of a consistent cost structure or cost language, the collection and analysis of cost data for completed projects, and providing for training in the areas of the development and validation of cost estimates.

However, RACER has its disadvantages as a parametric cost estimating model: it is considered to be more of a budget estimating tool than for detailed design; it lacks the capability of utilizing customized numbers; and it fails to recognize a time component in its calculations.

RACER is recognized by Congress and outside entities as a tool that is sufficiently developed and validated to develop budget quality cost estimates.

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APPENDIX D

SAVANNAH RIVER SITE

The SRS disposes of LLW on site in either slit trenches (lower activity waste, mainly soil and debris), engineered trenches (higher isotopic concentrations), or vaults (still higher activities and large equipment). Some LLW currently is also disposed off-site at NTS or the *EnergySolutions*, Clive, Utah facility. The SRS LLW and MLLW streams planned for off-site disposition through FY 2035 are presented below. The SRS MLLW is currently disposed offsite at NTS or the *EnergySolutions*, Clive, Utah facility. The SRS has not identified any treatment or disposal TBD waste streams.

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Table D-1

Off-Site Disposition of Savannah River Site MLLW Streams

Material	Destination	Quantity (m ³)										Total
		FY06	FY07	FY08	FY09	FY10	FY11- FY15	FY16- FY20	FY21- FY25	FY26- FY30	FY31- FY35	
MLLW Final Form ⁺⁺⁺	Commercial Site #2	6	2	1	1	1	6	10	0	0	0	27
MLLW Debris	Commercial Site #2	570	70	100	60	100	680	710	500	0	0	2,790
MLLW Homogen. Solids	Commercial Site #2	97	30	28	6	6	35	21	21	0	0	244
MLLW Liquid	Commercial Site #2	18	0.3	0.3	0.3	0.3	3	0	0	0	0	22
MLLW Liquid	Commercial Site #6	16	0.3	0.3	9	13	46	24	5	0	0	114
MLLW Final Form ^{\$\$\$}	NTS	0	200	0	0	0	0	0	0	0	0	200
MLLW Final Form ^{****}	NTS	100	0	43	0	0	0	0	0	0	0	143
MLLW 10-100 nCi/gm	NTS	300	82	440	400	130	200	0	0	0	0	1,550
MLLW Homogen. Solids	Oak Ridge (TSCAI)	0.7	0	0	0	0	0	0	0	0	0	0.7

⁺⁺⁺ This stream is a combination of various soil and solids waste streams. These streams will be treated with neutralization or stabilization/solidification before disposal.

^{\$\$\$} This waste stream was originally organic liquid which will be treated by stabilization and solidification before disposal.

^{****} This stream will be treated by macroencapsulation and other methods prior to disposal at NTS.

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Table D-2

Off-Site Disposition of Savannah River Site LLW Streams

Material	Destination	Quantity (m ³)										Total
		FY06	FY07	FY08	FY09	FY10	FY11- FY15	FY16- FY20	FY21- FY25	FY26- FY30	FY31- FY35	
LLW Debris	Commercial Site #2	1,200	1,300	1,200	1,200	1,200	4,900	3,200	16,200	0	0	30,400
LLW Homogen. Solids	Commercial Site #2	870	870	870	870	870	870	0	0	0	0	5,220
LLW Final Form ^{††††}	NTS	260	8	8	8	8	42	40	40	0	0	414
LLW Debris	NTS	69	0	0	0	0	0	0	0	0	0	69
LLW Homogen. Solids	NTS	48	28	28	28	28	28	0	0	0	0	188

^{††††} This waste stream was originally organic liquids treated by stabilization and solidification.

APPENDIX E

OAK RIDGE

Oak Ridge does not have any capability to dispose non-CERCLA LLW or MLLW on-site. Oak Ridge disposes of its non-CERCLA LLW and MLLW streams at either NTS or the EnergySolutions, Clive, Utah facility. The LLW and MLLW disposition data through FY 2035 for the Oak Ridge Site, which hosts the Oak Ridge National Laboratory (ORNL) and the National Nuclear Security Administration (NNSA) Y-12 site, are listed in Tables E-1 and E-2 below.

Table E-3 presents the current list of Oak Ridge TBD waste streams. Because there is a lack of treatment capacity for classified mixed waste, several waste streams containing classified shapes are TBD. However, it is planned to install a classified treatment and storage capacity under a special security plan.

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Table E-1

Disposition of Off-Site Oak Ridge MLLW Streams

Material	Destination	Quantity (m ³)										Total
		FY06	FY07	FY08	FY09	FY10	FY11- FY15	FY16- FY20	FY21- FY25	FY26- FY30	FY31- FY35	
MLLW Soil	Commercial Site #2	650	540	540	0	0	0	0	0	0	0	1,730
MLLW Debris	Commercial Site #2	2,400	120	120	50	50	50	50	0	0	0	2,840
MLLW Solids	Commercial Site #2	1,600	16	23	0	0	0	0	0	0	0	1,640
MLLW Liquid	Commercial Site #7	170	7	10	0	0	0	0	0	0	0	190
MLLW Solids	Oak Ridge (TSCAI)	90	220	150	0	0	0	0	0	0	0	460
MLLW Liquid	Oak Ridge (TSCAI)	210	54	31	0	0	0	0	0	0	0	295
MLLW Soil	TBD	0	0	0	0	0	42	0	0	0	0	42
MLLW Debris	TBD	5	540	505	31	0	0	0	0	0	0	1,080
MLLW Solids	TBD	0	0	39	0	0	0	0	0	0	0	39
MLLW Liquids	TBD	14	18	6	0	1	22	0	0	0	0	61

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Table E-2

Disposition of Off-Site Oak Ridge LLW Streams

Material	Destination	Quantity (m ³)										Total
		FY06	FY07	FY08	FY09	FY10	FY11- FY15	FY16- FY20	FY21- FY25	FY26- FY30	FY31- FY35	
LLW Soil	Commercial Site #2	170	170	170	10	40	430	50	50	50	50	1,200
LLW Debris	Commercial Site #2	3,300	2,500	1,100	300	300	2,300	0	0	0	0	9,800
LLW Solids	Commercial Site #2	1,800	1,400	1,700	2,000	2,400	6,400	5,000	5,000	5,000	5,000	35700
LLW Solids	Commercial Site #3	10	4	4	4	4	19	19	19	19	19	121
LLW Liquid	Commercial Site #3	58	17	23	4	4	21	21	21	21	21	211
LLW Liquid	Commercial Site #6	1	9	0	0	0	0	0	0	0	0	10
LLW Soil	NTS	18	18	18	0	0	0	0	0	0	0	54
LLW Debris	NTS	8,100	21,000	3,200	200	2,900	8,500	6,000	0	0	0	49900
LLW Solids	NTS	1,600	1,500	1,500	1,500	1,500	1,940	1,940	530	530	530	13100
LLW Soil	TBD	0	0	0	0	0	110	0	0	0	0	110
LLW Debris	TBD	0	0	0	7	60	1,740	0	0	0	0	1,810
LLW Solids	TBD	670	60	110	0	0	1	1	1	1	0	840
LLW Liquid	TBD	28	9	0	0	12	13	0	0	0	0	62

Table E-3

Oak Ridge LLW and MLLW TBD Waste Streams

Waste Stream	Remaining On-Site Containers	Final Treated Vol. (m ³)	Planned Treatment	Planned Treat Facility	Status	Planned Disposal
Classified Mixed Waste (D-Codes)	101	54	Shred Stabilization	Comm. Site #7	Lack of treatment capacity for classified MLLW Classified treatment/storage capacity to be installed under special security plan.	NTS
Classified Mixed Waste (F-Codes)	10	3.2	Shred/VTD/ Stabilization/ Debris wash	Comm. Site #7	Lack of treatment capacity for classified MLLW Classified treatment/storage capacity to be installed under special security plan.	NTS
Classified Mixed Waste (U-Codes)	3	1.3	Shred/VTD/ Stabilization/ Debris wash	Comm. Site #7	Lack of treatment capacity for classified MLLW Classified treatment/storage capacity to be installed under special security plan.	NTS
Dioxin/Furan Mixed Wastes	21 (6 classified)	12	VTD/ debris wash/ Chem Ox	Comm. Site #7	Lack of treatment capacity for classified MLLW Classified treatment/storage capacity to be installed under special security plan for classified portion (6 containers) Permit modification pending by commercial site #2 to include dioxin/furan waste codes.	Comm. Site #2/ NTS
RH Mixed Wastes	4	1	Stabilization	Comm. Site #7	Lack of treatment capacity for RH MLLW Evaluating facility mods to handle high dose Working agreement to treat at ORNL hot cell under TDEC temporary authorization or permit.	NTS

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**Table E-3
Oak Ridge LLW and MLLW TBD Waste Streams (Continued)**

Waste Stream	Remaining On-Site Containers	Final Treated Vol. (m³)	Planned Treatment	Planned Treatment Facility	Status	Planned Disposal
Combust Code Mixed Wastes	329	58	VTD	Comm. Site #7	Lack of treatment capacity for mixed wastes requiring treatment via combustion technology that cannot be incinerated at TSCAI Working with USEPA, Region IV on petition for Equivalent Treatment to use VTD Lack of approved Type B cask for shipment and burial at NTS	TBD
RTG ⁺⁺⁺	3	0.2	None	None	Obtain NTS determination on Type B equivalent inner package for disposition. Revise shipping Cask Cert of Compliance (CoC)/Safety Analysis Report for Packaging (SARP) for Sr-90 RTG's.	NTS
RH LLW Vaults	29	120	None	None	Dose hazards associated with repackaging. Generator characterization inadequate for NTS. Design and certify DOT compliant packaging for Type A shipment. Vaults do not meet DOT Type A/B specs. Repackage some vault contents into smaller DOT compliant packages	NTS
High Flux Isotope Reactor Beryllium Reflector/ Activated Metal	N/A	4	None	None	Certain isotopes will require waivers from disposal WAC Multiple contaminants couples with Co60 and Eu nuclides present significant handling and transportation issues Potential buildup of transuranic isotopes may exceed 100 nCi/gm.	TBD

⁺⁺⁺ RTG = Radioisotope Thermoelectric Generator

APPENDIX F

IDAHO NATIONAL LABORATORY

The INL disposes of most of its LLW on site at the RWMC. The contact-handled (CH) LLW is sent to the CH-LLW disposal pit while the remote-handled (RH) LLW goes to the RH-LLW concrete vaults. Remote-handled waste is packaged waste whose external surface dose rate exceeds 200 mrem per hour. In order to minimize dose exposure to the workers, these waste packages are manipulated via automated equipment, i.e. remotely. Contact-handled waste, in contrast, is packaged waste whose external surface dose rate does not exceed 200 mrem per hour. The Low-Level Waste Disposal Facility at the RWMC is scheduled to stop receiving contact handled LLW in 2008 and stop remote handled LLW receipts and close in 2009. The Department is currently evaluating the disposal options for both on-site and off-site disposal of INL site LLW after the SDA closes.

The INL CERCLA Disposal Facility (ICDF) disposes of soil and debris from CERCLA cleanup operations and is located southwest of the INTEC.

The projected INL waste streams for off-site disposal are listed below in Table F-1. Table F-2 lists the known INL TBD MLLW streams.

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Table F-1

Disposition of Off-Site Idaho National Laboratory LLW and MLLW Streams

Material	Destination	Quantity (m³)										Total
		FY06	FY07	FY08	FY09	FY10	FY11- FY15	FY16- FY20	FY21- FY25	FY26- FY30	FY31- FY35	
MLLW Solids	Commercial Site #2	660	190	30	110	90	130	0.2	0.2	0.2	0.3	1,210
MLLW Solids	Commercial Site #5	0.42	0.21	0	0	0	0	0	0	0	0	0.6
MLLW Solids	Commercial Site #6	5.8	0	0	0	0	0	0	0	0	0	5.8
MLLW Solids	Hanford (RL)	0	0	0	0	0	0.6	0.7	0.7	0.7	0.7	3
MLLW Solids	NTS	610	1,350	1,300	1,300	1,300	350	0	0	0	0	6,200
MLLW Solids	Oak Ridge (TSCAI)	0.2	0	0	0	0	0	0	0	0	0	0.2
LLW Solids	Commercial Site #2	0	0	0	960	960	4,700	2,800	0	0	0	9,400
LLW Solids	Hanford (RL)	0	0	0	0	40	200	200	200	190	200	10,000
LLW Solids	NTS	180	570	490	1,400	1,400	5,650	2,500	2,500	2,300	2,500	19,500

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Table F-2

Idaho National Laboratory TBD Waste Streams

Waste Stream	Volume (m ³)	Planned Treatment	Planned Treatment Facility	Status	Planned Disposal
CH-ANL-RPK, LiH &/or NaK Waste	0.34	SCMS	MFC	Class B, 1 container	RWMC
ID-INL-187/S1G Sodium	0.9312	SCMS	MFC	In process, one container	RWMC
ID-INL-800/Class B&C Waste	68.52	Macroencapsulation & Stabilization	Commercial Site #4	Class B&C, 48 containers	NTS
ID-INL-805/INTEC Class B&C Waste	48.72	Macroencapsulation & Stabilization	Commercial Site #4	Class B&C, 27 containers	NTS
ID-INL-801/Class A Waste	32.62	VTD	Commercial Site #2	Failed WERF Ash; 12 containers	Commercial Site #2
ID-INL-804/TSCA Waste	0.78	VTD	Commercial Site #4	Class B&C; 5 containers	NTS
LDR Compliant	13.82	Direct Disposal	NA	Class B&C; 14 containers	NTS
LDR Compliant	1.25	Direct Disposal	Commercial Site #7	In process, 6 containers	Commercial Site #2

MFC = Material Fuels Complex
 SCMS = Sodium Component Maintenance Shop
 VTD = Vacuum Thermal Desorption
 WERF = Waste Experimental Reduction Facility

APPENDIX G

RICHLAND OPERATIONS OFFICE AND THE OFFICE OF RIVER PROTECTION

All Hanford non-CERCLA LLW and MLLW will be disposed on site at the IDF as the primary disposal facility for those wastes as the smaller low level waste trenches currently in operation are filled and phased out. CERCLA wastes are dispositioned at the ERDF. Hanford plans to dispose the majority of its waste on site; however a small amount from the treatment of MLLW at PEcoS and Perma-Fix is currently being disposed at the EnergySolutions, Clive, Utah facility. The PEcoS facility is treating the waste by macroencapsulation, stabilization and thermal treatment, while the Perma-Fix facilities are primarily performing thermal treatment. PEcoS is receiving non-debris waste from the Hanford Site for thermal treatment. Some Hanford LLW is also being treated at PEcoS. PEcoS is contracted to volume reduce LLW and meet the Hanford Site waste disposal criteria. The soft debris and liquids are thermally treated and the residues are returned to the Hanford Site. The hard debris is cut up, super compacted and returned to the Hanford Site for disposal.

Hanford TBD MLLW Streams

LDR Treatability Group MLLW-08 “Unique Wastes”

- Chemical/Physical Nature : Beryllium Dust (P015), furans and dioxins (F022,F027)
- Radioactivity: Low levels
- Volume in storage: 1.3 m³
- Forecast volume: None
- Probable treatment requirements: RCRA specified technologies and organic destruction.
- Problem: Treatment not currently available for mixed wastes with these attributes.

LDR Treatability Group MLLW-06 “Mercury Wastes”

- Chemical/physical Nature: Elemental mercury and High Mercury Subcategories (> 260 ppm).
- Radioactivity: Low levels
- Volume in storage: 15 m³
- Forecast volume: 0.8 m³
- Probable treatment requirements: Amalgamation and mercury recovery technologies
- Problem: Limited treatment capability for high mercury mixed wastes, and some elemental mercury has been previously amalgamated but no LDR certifications for disposal purposes.

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LDR Treatability Group MLLW-10 “Reactive Metals”

- Chemical/physical nature: Primarily sodium metal stored in drums, and sodium metal contaminated debris
- Radioactivity: Low levels
- Volume in storage: 25 m³
- Forecast volume: 0.3 m³
- Probable treatment requirements: Deactivation
- Potential problems: Repackaging/transportation for treatment. Availability of facility to treat radioactive reactive metal wastes.

PCB Mixed Wastes

- Chemical/physical nature: Various physical waste types contaminated with various concentrations of RCRA constituents and TSCA PCB's.
- Volume in storage: 210 m³. Approximately 50% may be direct disposable (transformers/remediation waste) with Chemical Waste Landfill approval at Hanford.
- Forecast volume: Approximately 100 m³
- Probable treatment requirements: Organic Destruction
- Problem: Dose rates and or specific radionuclides at levels that exceed existing facility acceptance criteria/licenses.

LDR Treatability Group MLLW-07 “RH and/or Large Container Wastes”

- Chemical/physical nature: Primarily debris including large equipment with greater than 200 mrem/hr dose rate and/or greater than 10 m³ in package size.
- Radioactivity: Some high rad. (e.g. 10 rem on contact) and/or exceeding commercial treatment facility radioactive material license limits for specific isotopes (e.g. Sr₉₀, H₃, C₁₄).
- Volume in storage: 255 m³
- Forecast volume: 2,960 m³
- Probable treatment/handling requirements: Remote-handled capability, inspection/size reduction/repackaging followed by appropriate treatment.
- Problem: Much of this waste will exceed off-site facility limits in one or more areas: dose rate, specific radionuclide Ci limits, or size limits. Transportation off-site is also an issue. Hanford is planning on-site capabilities to address these problems.

APPENDIX H

PORTSMOUTH AND PADUCAH SITES

The Portsmouth Site disposes of its LLW at the *EnergySolutions*, Clive, Utah facility, while the bulk of its MLLW is dispositioned at either the TSCAI or the Clive facility. The Paducah Site LLW streams are disposed of at either NTS or the *EnergySolutions*, Clive, Utah facility, whereas the bulk of its MLLW is dispositioned at the Clive facility or the TSCAI. The Portsmouth site will transition into full scale D&D shortly, with the Paducah Gaseous Diffusion Plant (PGDP) Site following into D&D in the 2010-2012 timeframe.

The PGDP plans to process 590 m³ of MLLW liquid through the TSCAI in FY 2011-2015. However, this is a potential capability gap as the Department has not yet decided when the incinerator will cease operations. The TSCAI will continue operations at least until 2009. Beyond that date, its future is uncertain, and will be determined based on the inventory of wastes still needing thermal treatment and the availability of cost effective alternative treatment methods.

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Table H-1

Disposition of Off-Site Paducah MLLW Streams

Material	Disposal Site	Quantity (m ³)										Total
		FY06	FY07	FY08	FY09	FY10	FY11- FY15	FY16- FY20	FY21- FY25	FY26- FY30	FY31- FY35	
MLLW Soil	Commercial Site #2	460	2,500	1,600	920	5,600	27,500	2,800	0	0	0	41,400
MLLW Debris	Commercial Site #2	530	11	2	2	3	140	0	0	0	0	690
MLLW Solids	Commercial Site #2	270	54	52	81	61	600	200	0	0	0	1,320
MLLW Liquid	Commercial Site #2	4	4	1	0	0	0	0	0	0	0	9
MLLW TBC ^{§§§§}	Commercial Site #2	470	45	20	20	20	160	140	0	0	0	880
MLLW Debris	NTS	0	13	0	0	0	0	0	0	0	0	13
MLLW Liquid	Oak Ridge (TSCAI)	0	0	0	0	0	590	0	0	0	0	590
MLLW TBC	TBD	0	0	0	0	0	90	0	0	0	0	90

^{§§§§} TBC = To be characterized at a later date

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Table H-2

Disposition of Off-Site Paducah LLW Streams

Material	Disposal Site	Quantity (m ³)										
		FY06	FY07	FY08	FY09	FY10	FY11- FY15	FY16- FY20	FY21- FY25	FY26- FY30	FY31- FY35	Total
LLW Soil	Commercial Site #2	0	0	0	0	0	19,000	89,000	0	0	0	108,000
LLW Debris	Commercial Site #2	1,050	1,670	730	2,500	900	3,400	6,400	0	0	0	16,700
LLW Solids	Commercial Site #2	73,400	3,400	5,600	4,600	4,000	7,200	27	0	0	0	98,200
LLW Liquid	Commercial Site #2	0	0	0	0	0	1,800	0	0	0	0	1,800
LLW Soil	NTS	0	0	0	0	90	2,700	0	0	0	0	2,800
LLW Debris	NTS	0	850	730	2,490	900	26	9,400	0	0	0	14,400
LLW Solids	NTS	7,300	180	430	6,400	300	6,000	2,100	0	0	0	22,700

Paducah Waste Streams without Viable Treatment/Disposal Options

The PGDP site has identified one waste stream that may be TBD. The pentachlorophenol waste stream summarized below does not meet the appropriate WAC because of its EPA hazardous waste codes of F027 and D037. In addition, there may be other problem waste streams because a significant amount of waste from the Paducah DOE Material Storage Area (DMSA) and D&D projects has not been fully characterized.

RCRA/MIXED WOOD PRESERVATIVE (Pentachlorophenol)

- One container (14.5 kg)(0.21 m³)
- Dioxin waste F027, D037
- Mixed waste
- Perma-Fix is the only mixed waste facility with the F027 code on their permit.
- Currently there is no disposal option for treated F027 waste in the United States.
- Treat waste at Perma-Fix, and return treated F027 waste to Paducah.
- Paducah will try to delist treated F027 waste for disposal at commercial site # 2 or NTS.

Table H-3

Disposition of Off-Site Portsmouth LLW and MLLW Streams

Material	Disposal Site	Quantity (m ³)		
		FY06	FY07 – FY35	Total
MLLW	Commercial Site #2	400	0	400
MLLW	Oak Ridge – TSCA1	280	0	280
MLLW	TBD	140	0	140
LLW	Commercial Site #2	850	0	850

Portsmouth TBD Waste Streams

Several RCRA-regulated waste streams at Portsmouth have been identified as problematic because one or more of the key radiological constituents (⁹⁹Technicium, ²³⁵Uranium, and/or ²³⁵Uranium assay) exceed the NRC license limits, and therefore the WAC, of the available commercial mixed waste treatment facilities. LATA/Parallax Portsmouth (the Portsmouth Remediation and Waste Management Contractor) recently awarded a fixed price contract to Perma-Fix/M&EC for the offsite treatment of the Portsmouth problematic waste streams. Perma-Fix/M&EC plans to blend the mixed waste at Portsmouth to meet their WAC radiological limits and then ship the waste to their Oak Ridge, Tennessee, facility for RCRA treatment, with subsequent disposal planned at the DOE Nevada Test Site.

Each of the PORTS problematic waste streams is briefly summarized below. For each waste stream, the following information is provided:

- The volume currently in inventory
- The basis (hazardous waste code) for which it is hazardous
- Available radiological characterization information
- The treatment technology to be utilized
- Projected disposal path for the treated waste

W015 – Heavy Metal Sludge

- 26 containers (110's and B-25's) (841 ft³; 23.8 m³) (22, 827lbs)
- Characteristic for metals D006, D008, D009
- Many containers with high ²³⁵Uranium gram content, ⁹⁹Technicium
- On site Chemical Oxidation/Stabilization treatment
- Disposal at NTS

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W016 – Microfiltration Sludge and Filters

- 10 containers (drums) (41 ft³; 1.2 m³) (1,021 lbs.)
- Characteristic for metals D006, D008
- High ²³⁵Uranium gram content
- On site Stabilization treatment
- Macroencapsulation/shredding for filters
- Disposal at commercial site # 2.

W018 – Ion Exchange Resins

- 265 containers (drums, B-25s) (3,192 ft³; 90.4 m³) (127,504 lbs.)
 - 262 drums characteristic hazardous waste (DOO8 - <240 ppm Mercury)
 - 3 B-25 boxes of F001 Resin from x-701E – NOTE: each of these containers has >200 grams of ²³⁵Uranium in each container
- Some containers with high ²³⁵Uranium gram content, some with high ²³⁵Uranium assay, ⁹⁹Technicium (12-13x10⁶ pCi./g)
- Airborne rad contamination (⁹⁹Technicium, ²³⁵Uranium) anticipated during sampling/treatment – may require a glovebox or some type of enclosure
- On-site stabilization treatment for drums
- On-site Vacuum Thermal Desorption (VTD) treatment or possibly offsite TSCAI incineration for B-25 boxes (need to evaluate if TSCAI candidate – metals content and number of grams per box may not meet TSCAI WAC)
- Disposal at NTS

W022 – Waste Decontamination Solids

- 412 containers (F Cans, drums) (1,581 ft³; 44.8 m³) (68, 566 lbs.)
- Characteristic for metals D010/D011/D018, also F001/F002
- On-site stabilization treatment
- Disposal at commercial site #2.

W025 – HEPA Filters

- 4 containers (Lab Pack, drum, B-25 box), (202 ft³; 5.7 m³) (2,410 lbs.)
 - 3 containers characteristic for metals D006/D008/D009
- 1 container with F001 constituents (Evaluate moving this to MWIR W001 with other F001 Treatment Filters)
- Some containers with high ²³⁵Uranium gram content, some with high ²³⁵Uranium assay
- On-site Macroencapsulation treatment
- Disposal at commercial site #2.

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W026 – Metal Shavings and Scrap

- 204 containers (5 are classified) (drums) (1,796 ft³; 50.9 m³) (75,523 lbs.)
- Characteristic for metals D006, D007, D009, (1 unclassified container contains F001, F002 constituents/characteristics)
- Some containers with high ²³⁵Uranium gram content, some with high ²³⁵Uranium assay
- 1 container on site F001 VTD treatment
- Non classified treat onsite – On-site macroencapsulation treatment or treat at Duratek followed by disposal at NTS or on-site disposal cell
- Classified – must be treated on site, with subsequent disposal at NTS.

W027 – X-705A Incinerator Ash

- 41 containers (F Cans, Drums) (167 ft³; 4.7 m³), (3,950 lbs.)
 - 25 are in X-326 L Cage – Highly Enriched Uranium (HEU)
- Characteristic for metals D006, D007, D008, D009, D011
- Some containers with high ²³⁵Uranium gram content, some with high ⁹⁹Technicium
- Airborne rad contamination (²³⁵Uranium, ⁹⁹Technicium, transuranics) expected during sampling/treatment - may require a glovebox or some type of enclosure
- On-site stabilization treatment
- Disposal at NTS.

W036 – Seal Dismantling Scrap Metal

- 3 containers (drums) (30 ft³; 0.8 m³) (1,269 lbs.)
- Characteristic for metals D006, D008
- Containers expected to have high ⁹⁹Technicium
- On-site macroencapsulation treatment
- Disposal at commercial site #2.

W043 – Filter Tank Gunk (Dissolved trap material (sludge))

- 98 containers (drums) (1,048 ft³; 29.7 m³) (47,990 lbs.)
- Some containers with high ²³⁵Uranium gram content, some with high ⁹⁹Technicium
- Characteristic for metal D009
- Additional TCLP metals characterization data needed. Some rad and characterization data available.
- Airborne rad contamination (²³⁵Uranium, ⁹⁹Technicium, transuranics) expected during sampling/treatment - may require a glovebox or some type of enclosure
- On-site stabilization treatment
- Disposal at NTS.

W059 – Bag Filters

- 6 containers (drums) (35 ft³; 1.0 m³) (675 lbs.)
- Characteristic for metals D006/D009/D010/D011
- Containers have high ⁹⁹Technicium
- On-site macroencapsulation treatment
- Disposal at commercial site #2.

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W082 – HEU Waste

- 2 containers (8 ft³; 0.2 m³) (F- Can, drum)
- F-Can – D011 – Need to evaluate if this needs to be moved to W027 with other Filter Ash containers
- Drum – Lab Pack Characteristic for metals D008, P015 – Lab Pack container list indicates presence of Tower Ash – transuranics present
- Airborne rad contamination (²³⁵Uranium, ⁹⁹Technicium, transuranics) expected during sampling/treatment - may require a glovebox or some type of enclosure
- Treat drum on site, with subsequent disposal at NTS.

W083 – Alumina Trap Material

- 188 containers (F-Cans, Drums, B-25 Boxes) (1,918 ft³; 54.3 m³)
- Characteristics for metals D004, D005, D006, D007
- Additional TCLP metals characterization data needed. Some rad and characterization data are available.
- Some containers with very high ²³⁵Uranium gram content (i.e. 858 grams), some with high ⁹⁹Technicium
- Airborne rad contamination (²³⁵Uranium, ⁹⁹Technicium, transuranics) expected during sampling/treatment - may require a glovebox or some type of enclosure
- On site stabilization treatment
- Disposal at NTS.

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APPENDIX I

ACRONYMS

ACE	Applied Cost Engineering
AEA	Atomic Energy Act
ALARA	As Low as Reasonably Achievable
BOA	Basic Order Agreement
BSFR	Bulk Survey for Release
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CID	Central Internet Database
CPIF	Cost-Plus Incentive Fee
D&D	Deactivation and Decommissioning
DAW	Dry Active Waste
DEQ	Department of Environmental Quality
DMSA	Paducah DOE Material Storage Area
DoD	Department of Defense
DOE	Department of Energy
DOECAP	DOE Consolidated Audit Program
DOE-OR	DOE Oak Ridge Operations Office
DSSI	Perma-Fix Diversified Scientific Services
ECAS	Environmental Cost Analysis System
EH	Office of Environment, Safety and Health
EH-1	Assistant Secretary for Environment, Safety and Health
EIS	Environmental Impact Statement
EM	Environmental Management
EMWMF	Environmental Management Waste Management Facility
EPA	U.S. Environmental Protection Agency
ERDF	Environmental Restoration and Disposal Facility
ETTP	East Tennessee Technology Park
GAO	Government Accountability Office
GTCC	Greater than Class C
HFIR	High Flux Isotope Reactor
ICDF	Idaho CERCLA Disposal Facility
IDF	Integrated Disposal Facility
ID/IQ	Indefinite Delivery/Indefinite Quantity Contract
ILAW	Immobilized Low Activity Waste
INL	Idaho National Laboratory
INTEC	Idaho Nuclear Technology and Engineering Center
IPABS	Integrated Planning, Accountability, and Budgeting System
LLBG	Low Level Burial Grounds
LLRWPA	Low-Level Radioactive Waste Policy Amendments
LLW	Low-Level Waste
m ³	cubic meters
M&EC	Perma-Fix Materials and Energy Corporation
MFC	Material Fuels Complex
MLLW	Mixed Low-Level Waste

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NARM	Naturally-Occurring or Accelerator-Produced Radioactive Material
nCi/g	nanocuries per gram
NCSE	Nuclear Criticality Safety Evaluation
NEPA	National Environmental Policy Act
NDS	National Low-Level Waste/ Mixed Low-Level Waste Disposition Strategy
NIST	National Institute of Standards and Technology
NNSA	National Nuclear Security Administration
NTS	Nevada Test Site
NTSWAC	Nevada Test Site Waste Acceptance Criteria
NRC	Nuclear Regulatory Commission
ORNL	Oak Ridge National Laboratory
PCB	polychlorinated biphenyl
PEIS	Programmatic Environmental Impact Statement
PGDP	Paducah Gaseous Diffusion Plant
PPPO	Portsmouth and Paducah Project Office
RACER	Remedial Action Cost Engineering and Requirements
RTG	Radioisotope Thermoelectric Generator
RCRA	Resource Conservation and Recovery Act
ROD	Record of Decision
RWMC	Radioactive Waste Management Complex
RWMS	Area 5 Radioactive Waste Management Site
SCMS	Sodium Component Maintenance Shop
SDA	Subsurface Disposal Area
SDD	Stream Disposition Data
SEPA	State Environmental Policy Act
SRS	Savannah River Site
TBD	To Be Determined
TCEQ	Texas Commission on Environmental Quality
TDSHS	Texas Department of State Health Services
TRU	Transuranic Waste
TSCA	Toxic Substances Control Act
TSCAI	Toxic Substances Control Act Incinerator
TSDF	Treatment, Storage or Disposal Facility
VTD	Vacuum Thermal Desorption
WAC	Waste Acceptance Criteria
WCS	Waste Control Specialists
WERF	Waste Experimental Reduction Facility
WIMS	Waste Information Management System
WIPP	Waste Isolation Pilot Plant
WTP	Waste Treatment Plant

APPENDIX J

GLOSSARY

11e.(1) Byproduct Material – any radioactive material (except special nuclear material) yielded in or made radioactive by exposure to the radiation incident to the process of producing or utilizing special nuclear material.

11e.(2) Byproduct Material – the tailings or waste produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material (i.e., uranium, thorium, or both) content.

11e.(3) Byproduct Material – any discrete source of radium-226, that is produced, extracted, or converted by extraction, before, on, or after the date of enactment [Energy Policy Act of 2005] for use for a commercial, medical, or research activity, or any material that has been made radioactive by use of a particle accelerator and is produced, extracted or converted after extraction, before, on, or after the date of enactment [Energy Policy Act of 2005] for use for a commercial, medical, or research activity.

11e.(4) Byproduct Material – any discrete source of naturally occurring radioactive material, other than source material, that the Commission, in consultation with the Administrator of the U.S. Environmental Protection Agency, the Secretary of Energy, the Secretary of Homeland Security, and the head of any other appropriate Federal agency, determines would pose a threat similar to the threat posed by a discrete source of radium-226 to the public health and safety or the common defense and security, and before, on, or after the date of enactment [Energy Policy Act of 2005] is extracted, or converted after extraction for use in a commercial, medical, or research activity.

Class A, B, C, and Greater Than Class C LLW – classifications generally refer to commercial LLW and not DOE LLW. However, the classifications are relevant when DOE sends its waste to a commercial facility (which is regulated by NRC) for disposal. The NRC waste disposal regulations (10 CFR Part 61) establish four classes of commercial low-level waste, based on the concentration of specific radionuclides. Three classes, A, B, and C, are considered suitable for shallow land burial, while a fourth class, "Greater Than Class C" (GTCC), requires special disposal facilities. Class A waste contains the least radioactivity, most of which comes from relatively short-lived radionuclides, which decay to background levels within a few decades. Class B waste is also relatively short-lived, but contains higher concentrations of short-lived radionuclides than in Class A. Class C waste can contain higher concentrations of both short-lived and long-lived radionuclides, while GTCC is higher still.

Classified Material - radioactive material to which access has been limited for national security reasons.

Compaction/Supercompaction – involves the use of force (e.g., hydraulic drivers) to reduce waste volumes thereby minimizing the needed disposal capacity.

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Contact-Handled Waste – is packaged waste whose external surface dose rate does not exceed 200 mrem per hour.

Disposal -- emplacement of waste in a manner that ensures protection of human health and the environment within prescribed limits for the foreseeable future with no intent of retrieval and that requires deliberate action to regain access to the waste.

Disposition – endpoint treatment/processing or disposal for the purposes of this document. Disposition may result in a successor waste stream as a result of treatment and processing.

Dried Active Waste – Solid radioactively contaminated trash from nuclear facilities, such as paper, booties, and gloves.

Hazardous Waste – non-radioactive waste containing a hazardous component subject to the Resource Conservation and Recovery Act, as amended, or defined as hazardous by state regulation (for the purposes of this document, includes waste regulated under TSCA).

Incineration -- High temperature organic destruction operated in accordance with the applicable requirements of 40 CFR part 264, subpart O, or 40 CFR part 265

Low-Level Waste (LLW) -- radioactive waste that is not high-level waste, spent nuclear fuel, transuranic waste, byproduct material (as defined in Section 11e of the Atomic Energy Act of 1954, as amended), or naturally occurring radioactive material, per *DOE Order 435.1*. Commercial LLW is categorized per NRC regulations as Class A, Class B, Class C or Greater than Class C. Although these classifications are not directly applicable to DOE waste, the classifications are relevant when DOE sends its waste to a commercial facility (which is regulated by NRC) for disposal. These classifications are defined above.

Macroencapsulation -- Application of surface coating materials such as polymeric organics (e.g. resins and plastics) or use of a jacket of inert inorganic materials to substantially reduce surface exposure to potential leaching media.

Metal Melting – involves the use of high temperature furnaces to melt and reform radioactively contaminated metals (e.g., scrap metal). Depending on the contamination levels, the resulting product may be recycled for controlled government or commercial uses (e.g., shielding blocks).

Mixed Low-Level Waste (MLLW) – low-level waste, as defined above, also containing a hazardous component subject to the Resource Conservation and Recovery Act as amended.

Neutralization -- Neutralization with the following reagents (or waste reagents) or combinations of reagents:(1) Acids; (2) bases; or (3) water (including wastewaters) resulting in a pH greater than 2 but less than 12.5 as measured in the aqueous residuals.

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Naturally Occurring and Accelerator Produced Radioactive Material (NARM) – is any radioactive material that can be considered naturally occurring (and is not source, special nuclear, or byproduct material) or that is produced in a charged particle accelerator.

Naturally Occurring Radioactive Material (NORM) – Naturally occurring materials not regulated under the *Atomic Energy Act of 1954*, as amended whose composition, radionuclide concentrations, availability, or proximity to man have been increased by or as a result of human practices. NORM does not include the natural radioactivity of rocks or soils or background radiation.

Other Thermal Treatment – Thermal treatments similar to Vacuum Thermal Desorption described below employing the same basic principle of physical separation.

RCRA Subtitle C – RCRA Subtitle C establishes the federal program to manage hazardous waste from cradle to grave. The program ensures that hazardous waste is handled in a manner to protect human health and the environment. To this end, there are Subtitle C regulations for the generation, transportation, and treatment, storage or disposal of hazardous waste.

RCRA Subtitle D – RCRA Subtitle D regulates the management of non-hazardous solid waste such as municipal wastes and non-hazardous industrial solid waste.

Release of Waste – The exercising of DOE's authority to release property that has been declared waste from its control after confirming that residual radioactive material on the waste has been determined to meet the guidelines for residual radioactive material in accordance with DOE 5400.5, *Radiation Protection of the Public and the Environment*, and other applicable radiological requirements.

Remote-Handled Waste – is packaged waste whose external surface dose rate exceeds 200 mrem per hour.

Sanitization – Any process applied to classified radioactive material the result of which is unclassified material.

Sanitary Waste – is non-hazardous, non-radioactive waste. Examples include waste generated by routine site support operations such as food service/cafeteria wastes, waste office paper, corrugated packaging materials and building construction or maintenance materials and debris.

Sealed Sources – Radioactive material encapsulated, or sealed, in a metal container such as stainless steel, titanium, or platinum. Sealed sources are used in medicine, research, agriculture and industry.

Sort/Segregate – Any waste/material processing resulting in physical sorting and or separating of a portion of the waste/material.

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Stabilization/Solidification – Typically involves mixing the waste/material matrix with one, or more, reagents to limit the leachability or mobility of radioactive and/or hazardous contaminants. Examples of solidification/stabilization agents include Portland cement, gypsum, modified sulfur cement and lime/pozzolans (e.g., fly ash and cement kiln dust). Additional agents (e.g., iron salts, silicates, clays) are sometimes used to enhance the set/cure time and/or compressive strength of the stabilized/solidified product.

Stream -- a grouping of waste or material having the same type (e.g., MLLW), physical and contaminant characteristics, management requirements (i.e., same disposition path), and barriers to disposition.

Surface Decontamination – the application of various technologies designed to remove hazardous and/or radioactive contaminants from the surface of debris-type waste/material matrices. Example technologies include abrasive blasting, scarification/grinding/planing, spalling, vibratory finishing, high pressure steam/water sprays, and chemical extraction.

Transuranic – an element, such as plutonium, that is beyond uranium in the periodic table.

Treatment – Any method, technique, or process designed to change the physical or chemical character of waste to render it: less hazardous; safer to transport, store, or dispose of; or reduce its volume.

Vacuum Thermal Desorption – Physical separation processes designed to remove volatile hazardous and/or radioactive contaminants from the waste matrix. Typically involves heating the waste under either oxidizing or non-oxidizing conditions to vaporize the volatile contaminants with a vacuum system transporting the contaminants to a subsequent gas treatment system.

Waste Acceptance Criteria (WAC) -- are the technical and administrative requirements that a waste must meet in order for it to be accepted at a storage, treatment or disposal facility.

Waste Characterization – is the identification of waste composition and properties, by review of acceptable knowledge (which includes process knowledge), or by nondestructive examination, nondestructive assay, or sampling and analysis, to comply with applicable storage, treatment, handling, transportation, and disposal requirements.

Waste Certification – is the process by which a waste generator affirms that a given waste or waste stream meets the waste acceptance criteria of the facility to which the generator intends to transfer waste for treatment, storage, or disposal.